Editorial

THE New Year which is now with us is likely to be momentous in many ways. We seem to have entered a period of transition in which we will say good-bye to many things which have been with us so long they have become fixtures in our minds.

I make this remark with special application to radio and associated matters, but of course it applies to broader issues which must have a bearing upon them.

In radio, the biggest transition which is now crowding our doorstep, is, of course, television. We can now see that its impact is likely to be vast, even though that impact may not be upon us for some little time.

Overseas, many contentious matters are likely to be settled this year which have been building up for quite a while. I feel that radio men all over the world have their eyes keenly focused on the USA at present, and its experiences with color. Although the outcome of it all is rather hard to forecast, it seems certain that something like a showdown is approaching which will have a fundamental effect on the future of color for some time to come. This issue will probably be advanced materially during 1951, although frankly I don't think it is likely to affect our own television plans, such as they are.

World events are bound to have a vital bearing on television generally. Until they are more settled, it is hard to avoid the conclusion that other things will have to come first. Personally I am less inclined to even suggest a possible outcome than I have been for some time.

Another transition we will face this year is of course in the recording field, in which the long playing record will be the star piece. A great deal of "wait and see" is going on at the moment which cannot continue indefinitely. Here the outlook is brighter, however, for in any event, we can look forward to better recording and reproducing standards than we have had in the past.

As to the uncertainties of which we are all only too well aware, I can only hope, with you, for the best. The year just completed brought us all many anxieties and trials. It is our wish for all our friends and readers that these will be greatly lessened before 1951 draws to a close.

John Moyle

INDEX

Page

Britain's Baby Radio — — — — — 3
US. Has Color TV Indigestion — — 4
Balloon Searches For Meson — — 5
Super-Sonics In Industry — — — — 7
Tomorrow's Color Music — — — — 11
Petrol Power Without Ping — — — 12
Technical Review — — — — — — — 15
Allied Petroleum Bomb — — — — 19
News And Views — — — — — — — 21
The New Babygram — — — — — — 24
The Serviceman Who Tells — — — 33
A Microphone Preamplifier — — — 36
Here's Your Answer, Tom — — — 46

Page

A Double Conversion Superhet — 48
A Course In Television — — — — 55
You Can Make Records At Home — 60
Elements Of Pulse Modulation — — 66
A Reader Built It — — — — — — — 69
Trade Notes — — — — — — — — — 71
Canberra Bomber For Australia — 73
A Jet Propelled Model Plane — — 75
The ABC Of Developing Film — — 77
Short Wave Notes — — — — — — 84
The Ham Bands — — — — — — — 87
Off The Record — — — — — — — 90
Answers To Correspondents — — — 93
Let's Buy An Argument — — — — 41

RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

Symbolical of our interest in recordings is this picture of a disc being cut by a typical home recording unit.

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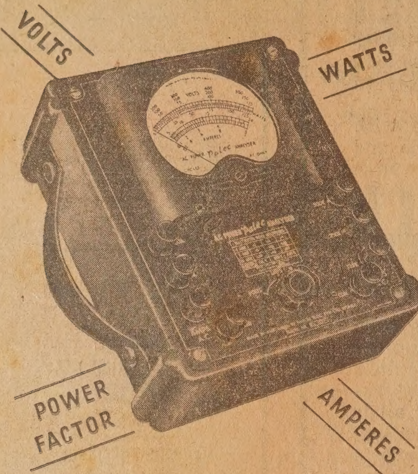

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1

The Palec A.C. Power Analyser, Model PA, Australia's first dynamometer multi-meter, for electrical service, maintenance and testing.

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Price: £23/15/- plus tax.

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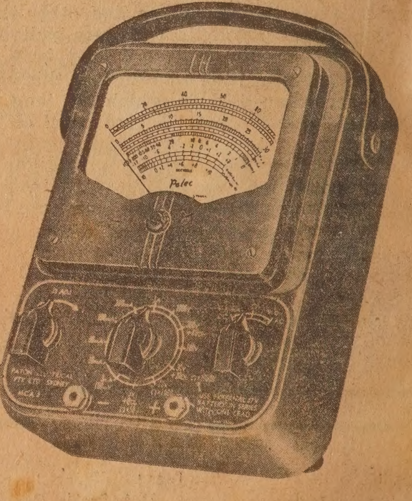

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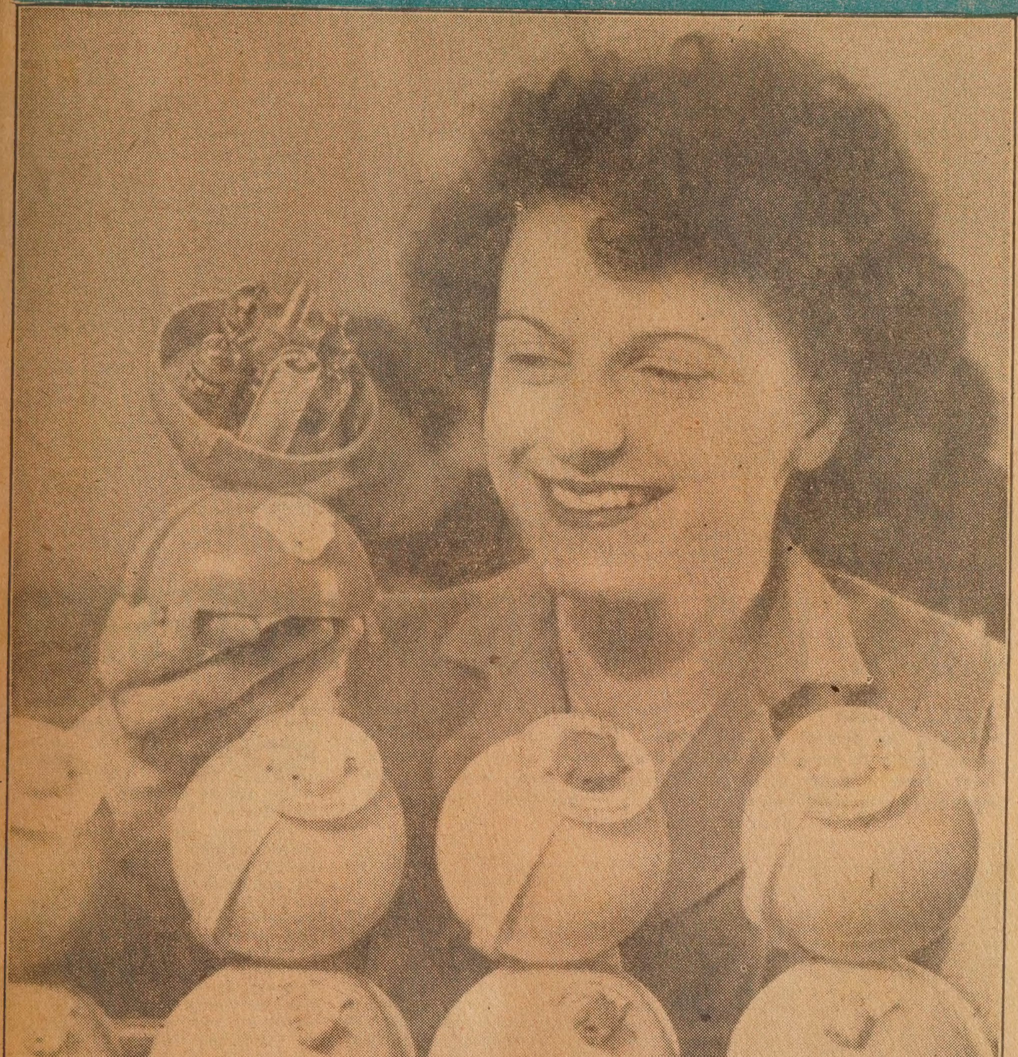
BRITAIN'S BABY RADIO RECEIVER



ALICE PICKET, 19-year-old assembly worker, pictured here with models of the "Pixytone," one of the world's smallest mains wireless sets, at the Ingleburne Products Ltd., factory in Malmesbury, Wilts. England. These globe-semi-globe models were intended originally to be electric table lighters, but a visitor to the factory jokingly remarked to one of the firm's directors that the neat little gadgets would make fine miniature radio sets. The firm took the joke seriously, and now Pixytones are coming off the assembly line at the rate of 1000 per week. Five inches high and two pounds in weight, they can be used on mains, in a car, or carried about with a dry battery for power. Not yet available on the home market, the Pixytone is designed to sell for under £6. The model is earning dollars overseas.

Public demonstrations of the CBS TV color system have been widely publicised in USA. Initial reaction was good, but reports indicate that many are convinced they should wait for something better.

U.S.A. HAS TV COLOR INDIGESTION

America has color TV—or has she? Thus we wrote in a recent article reviewing the position in that country. The answer to this question seems harder to make than ever as events move rapidly on the color front. From a welter of conflicting reports, it seems likely that, far from moving forward, recent events have, without doubt, confused the position more than ever.

PRIMARY thought is that if the FCC considered it was helping to solve the TV deadlock by allowing the CBS system to go ahead, it is the only body which did.

In the first instance, the radio industry almost to a man is either lukewarm or openly hostile to the use of the CBS system. It seems to be another case of leading the horse to the water—in this case, the promising pastures of a color TV future—but finding out with a jarring jolt that the beast had other ideas about drinking.

RCA, the protagonists of the electronic color method, and who are unquestionably making ingenious progress along this line, made it clear that rejection of its claims would not easily be accepted. It all but ridiculed the idea that any mechanical method at this stage of the art could have any future, apart altogether from the relative position at the moment. It also emphasised that the electronic system was compatible with black and white, whereas the CBS system was not. It could see only chaos in using even temporarily a system considered fundamentally unsound.

RCA therefore filed a suit for an injunction to prevent CBS from proceeding with the approved plan, although few were optimistic about bucking a Government body such as the FCC, which controls these matters in USA.

A temporary victory was won, however, when a temporary restraint was ordered which prevented CBS from commencing on November 20, according to report.

As this will mean the re-examination of many thousands of pages of evidence from the original hearing, a final decision may take some time.

The position of set manufactures in USA seems now to be ranged alongside RCA as being the only other prominent contender for acceptance. In the absence of further advice as we go to press, the matter now rests there.

In the meantime, CBS is holding demonstrations on a wide scale, and these are receiving, at least initially, public approval. It is doubtful, however, whether this approval can be more than an understandable reaction to seeing color at all, as until RCA are able to counter these demonstrations with others of their own, there is no opportunity for comparison. Already there are signs that public approval might well be qualified when that happens. After all, the man in the street is probably hardly aware of the political issues involved.

CBS have gained many bad friends through advertising campaigns obviously designed to panic through the acceptance of their system.

Recently they told the public in big spreads that their children would feel left out if others had color television while their home did not. Many thought CBS and its backers were badly off for a reasoned case if they were forced to play up headlines such as, "There Are Some Things a Son or Daughter Won't Tell You." Even the firm which placed the advertisement admitted that it was out of bounds as far as taste was concerned.

How is all this mess affecting sales? Reports again suggest unfavorably. There is talk of a tremendous slump in sales—in some areas as much as 75 per cent in TV sets. This reaction is inevitable where there is too much talk about something which has so obviously gone off half-cocked.

It is highly probable that RCA will not allow anything to stand in their way to kill the FCC decision. A High Court appeal would probably delay matters again as much as a year. And so much can happen in that time. Meanwhile, the whole future stability of TV could be affected.

To make matters worse, world conditions may yet enforce such demands on the radio industry that TV and other things may quietly fold up until the possible enormous drain on labor and materials for defence can be lessened.

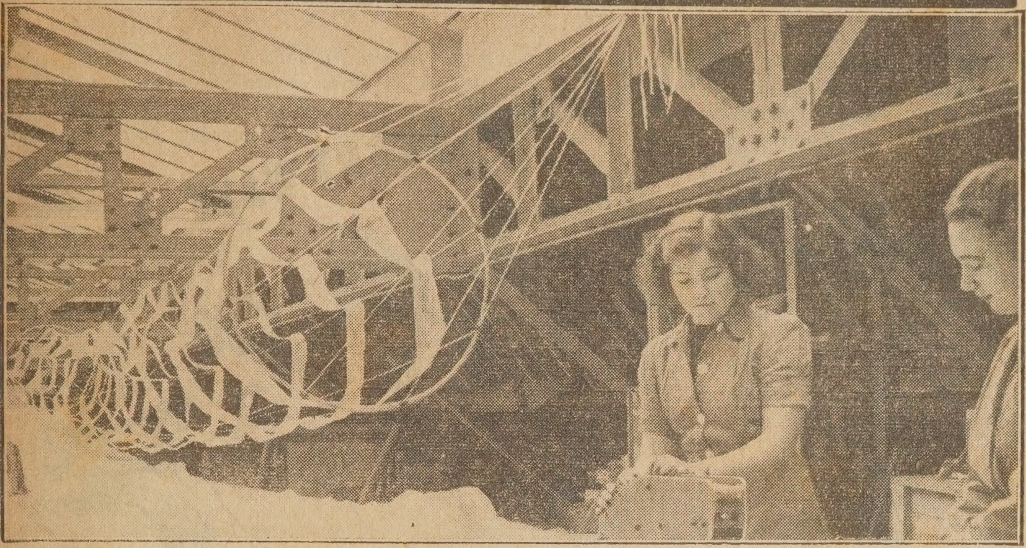
There is an object lesson in this, to which Australia cannot be blind. It seems as though things are working out pretty much as was to be expected from a reasoned approach to the whole subject.

DRILLING HINTS

AFTER marking a position on a chassis or panel, always use a centre punch before attempting to drill. Failure to do this results in much inaccurate work on the part of beginners, since it is almost impossible to prevent the drill from "wandering" over the work for the first half-dozen revolutions. Since this destroys the original mark, it is impossible to see by how much the final position of the hole is in error.

Where a large hole is required it is best to start with a small drill and increase in three or four steps until the desired size is reached.

BIG BALLOON SEARCHES FOR MESON



This balloon takes more than junior's lung power to inflate. Here assistants seal by heat the seams. Suspended from the girders is the guard for the gas escape tubes.

More and more men are realising the importance of learning all they can about what lies above them in space. Atmospheric and Ionospheric research is daily providing more of the answers to vital problems affecting not only radio but life itself.

ONE of the difficulties experienced in any examination of space even 50 miles above the earth is the virtual impossibility of existing at that altitude, even if the means were readily available to go there.

As a result, man has been forced to rely on observations made either with instruments on the earth's surface, or by recording devices sent aloft by various means.

The use of radio pulses to be reflected from objects far beyond the earth, using the radar technique, has resulted in quite reliable information about the composition of the atmosphere, and even the rotation of the earth. It is safe to say that we can expect even more startling results in this line than the now almost commonplace observation of radio pulses reflected from the surface of the moon.

Britain's atomic scientists, led by Nobel prize-winner Professor C. F. Powell, are planning to explore 25 miles into the stratosphere in the search for the elusive Meson—the atomic particle too minute to be seen by any microscope, but which may yet hold the clue to the mysterious binding force of the atom nucleus. For, despite the advances in atomic research, there are probably still worlds within worlds to be discovered and explored.

For their high altitude research, scientists at the Bristol University are shortly hoping to release a 100 feet diameter balloon, forerunner of a mammoth twice that size expected to be ready in a few months.

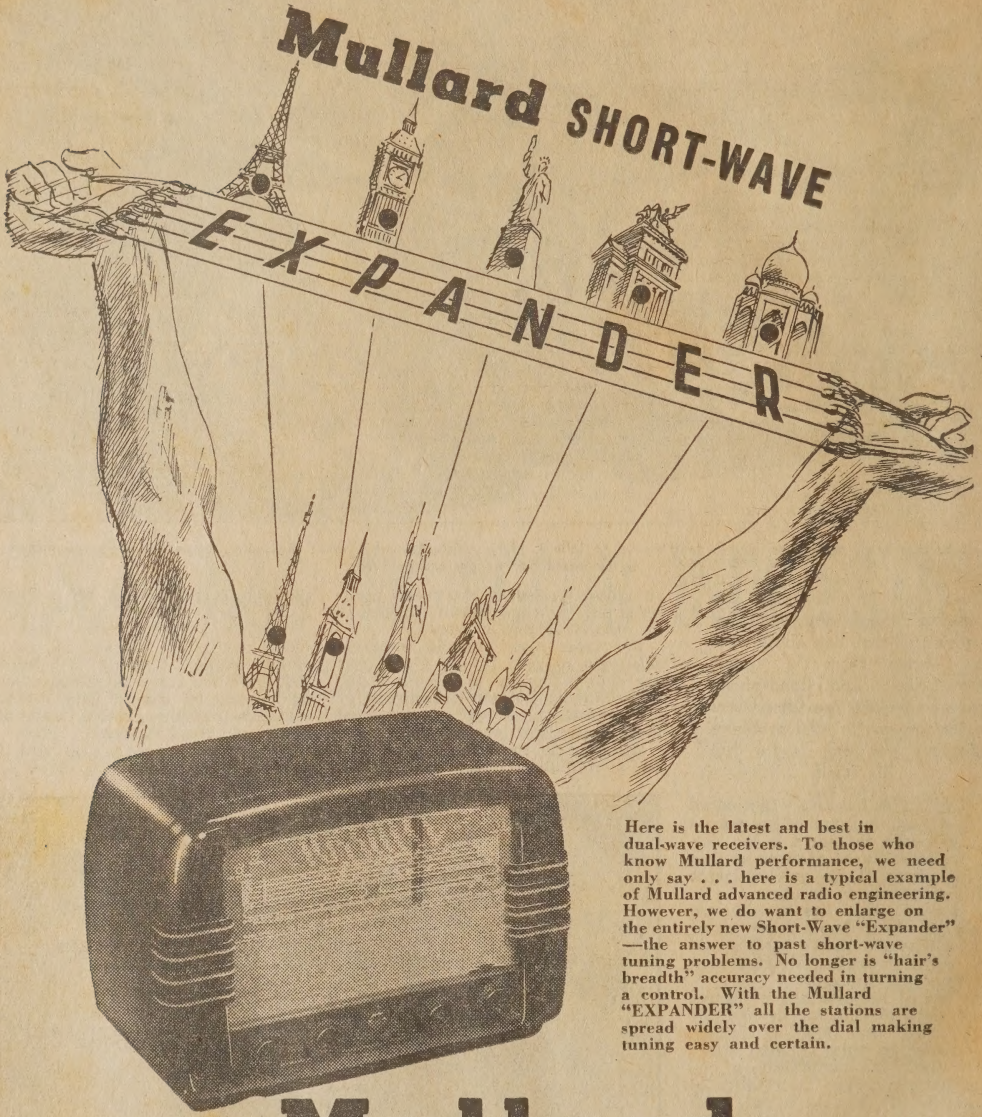
Attached to the trial balloon will be a miniature radio transmitter, photograph plates, and an ordinary alarm clock.

Ringing of the alarm will close an electric circuit, releasing a parachute holding the plates. It is hoped that particles from outer space will be trapped by the emulsion of the plates before they collide with air atoms and are destroyed.

It is probable that a year will be needed to examine each plate.

The radio transmitter in a watertight compartment is loaded. The timing device is a common alarm clock. Cut off mechanism for releasing the parachute and the sand release for controlling level flight can also be seen.

WORLD TUNING IS NOW much EASIER TUNING WITH . . .



Here is the latest and best in dual-wave receivers. To those who know Mullard performance, we need only say . . . here is a typical example of Mullard advanced radio engineering. However, we do want to enlarge on the entirely new Short-Wave "Expander" —the answer to past short-wave tuning problems. No longer is "hair's breadth" accuracy needed in turning a control. With the Mullard "EXPANDER" all the stations are spread widely over the dial making tuning easy and certain.

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ULTRASONICS INVADING INDUSTRY

Ultrasonics, the branch of science which deals with sonic waves above the range of audibility, has been a subject of research for more than 30 years, particularly in the United States, Germany and Britain. From the outset it looked as if it could be put to immediate commercial uses, but, although it offers intriguing prospects in a great many directions, it is only just beginning to come into its own.

BY LANGSTON DAY

AMONG other things ultrasonics can be used for flaw-testing in metals, depth-sounding and navigation, producing stable emulsions, removing soot and grit from flue gases, producing metal alloys, cleansing rayon and cotton waste, laundering, killing bacteria, purifying water, ageing beer and spirits, administering depth massage, providing aids for the blind and "memory units" for electronic calculators.

There is now an ultrasonic soldering iron operated on alternating current, which overcomes one of the difficulties of soldering, the formation of refractory oxides. High intensity ultrasonics produces cavitation, the effect caused through the presence of vapor bubbles in the liquid. When these bubbles collapse, extremely high pressures are created which destroy the troublesome oxide film.

HIGH AND LOW FREQUENCIES

Two of the principal ways in which ultrasonic waves are generated are by means of crystals, which vibrate in an electrical field, and by magnetostrictive metals which slightly change their length in a magnetic field. An alternating current is superimposed on a constant direct current and the resulting combined electromagnetic field is allowed to act on a nickel rod which oscillates and emits ultrasonic waves. Each method can produce waves of high or low frequency, both of which have their uses.

Some United Kingdom firms with long experience of ultrasonics have lately developed instruments which are being used to an increasing extent in the chemical and engineering industries. At an exhibition arranged this year by the British Welding Association, for example, demonstrations were given of weld-testing by ultrasonics as applied to the all-welded steel structures in the new giant steelworks at Margam, in Wales.

In this sort of work echo testing techniques are employed which are analogous to those of radar, made possible because of the unusual properties of ultrasonic waves. If their frequency is high the waves can be propagated along narrow beams and they behave somewhat like beams of light, obeying the laws of reflection and refraction. Thus, when they strike the interfaces of flaws they are reflected back to a greater or lesser extent, and these reflections, or echoes, can be picked up and recorded.

ANGLE-BEAM TRANSMITTER

Formerly in testing, an ultrasonic beam was projected straight into the weld, but for several reasons the usefulness of this method was limited. The new method uses an angle-beam transmitter with an ultrasonic reflectoscope. By this arrangement the ultrasonic beam is deflected at an angle from the normal, and it is only necessary to place the probe, or search unit, on a smooth part of the metal adjacent to the weld, or even at some distance away from it. The ultrasonic waves can be made to travel almost parallel to the face of the weld.

This has been found a much more satisfactory method. Welds in steel plates up to five inches (12.7 centimetres) thick, or in thin walls down to a thickness of one-sixteenth of an inch (1.6 millimetres) can be successfully probed for flaws; welds in tank walls, pressure vessels, plates and pipes—in fact, any type of weld comes within its scope.

The mechanism of the apparatus is highly ingenious. The waves are propagated in extremely short pulses of from one to three micro-seconds and the echoes are picked up by crystal probes and converted into electric signals. These are amplified and displayed on the screen of a cathode-ray tube along with the signals due to the transmission of the original pulses. The cathode-ray beam sweeps across the screen in synchronism with the pulses, and the quiescent period is made just long enough to allow echoes from the far side of the steel beyond the weld seam to be reflected back to the receiving probe before the next pulse is transmitted. If signals are received earlier than normally this indicates a flaw.

It is possible by this method to pick up tiny flaws as small as half a millimetre in length.

HIGH PENETRATING POWER

Another special feature of ultrasonic waves is their high penetrating power, which gives them a great

A kettle of liquid air boils when placed on a block of ice. Air stays liquid only at 192 degrees C below zero, so that the ice actually assists in its vaporisation. A picture taken at the recent Chemical Exposition in the Sydney Town Hall.

FOR THE **BEST** RESULTS . . .
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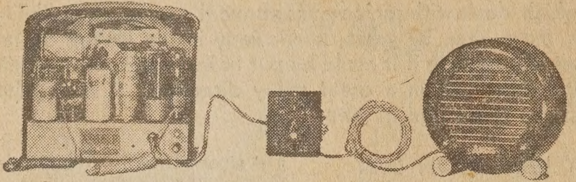

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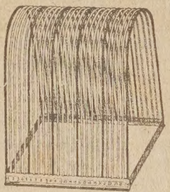

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The new improved Gramo record rack.

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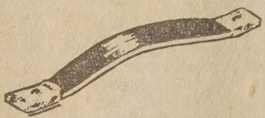
- Complete with index card and gummed identification numbers for the records -- **25/-**

New model now available to hold 50 records -- -- **33/-**



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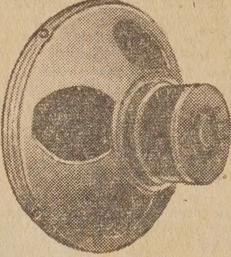

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6292	60ma	290/290v	44/8
6382A	60ma	385/385v	52/6
8302	80ma	300/300v	50/9
8383A	80ma	385/385v	58/8
10302	100ma	300/300v	56/-
10383A	100ma	385/385v	66/6
12383	125ma	385/385v	76/1
15403	150ma	400/400v	96/3
20353	200ma	350/350v	106/-
20453	200ma	450/450v	118/1

RED LINE FILTER CHOKES

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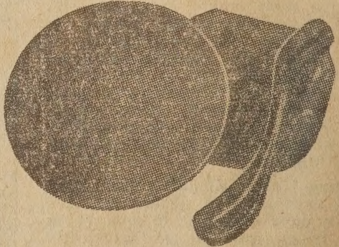
50825	80ma	30hy	36/4
301214	120ma	30hy	40/6
201515	175ma	25hy	43/3
102512	250ma	15hy	52/11

FILAMENT TRANSFORMERS

7038	230v6.3v	24/6
A246	Auto 2, 5, 4, 6.3v	24/6

STEPDOWN TRANSFORMERS

1104	230/115v	40 watt	56/10
1107	230/115v	75 watt	65/7
1115	230/115v	150 watt	105/-



NEW PLESSY RECORD PLAYER

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advantage over X-rays for testing. Some of the United Kingdom made detectors operate on a number of different frequencies to penetrate depths ranging from two inches (five centimetres) to 12ft (3.6 metres).

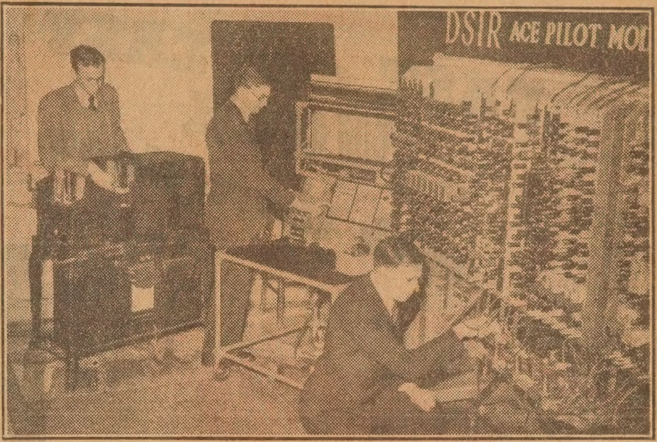
Ultrasonic flaw-testing has been used with success on costly austenitic alloy steel forgings for gas turbine rotors which rotate at 30,000 revolutions a minute and heat up to as much as 750 degrees Centigrade. It is absolutely essential that they contain no flaws, but since the rotor blanks are six inches (15.2 centimetres) thick and from nine to 40 inches (23 to 100 centimetres) in diameter, X-ray testing is out of the question. In fact, ultrasonic detectors in cases such as this are without rival.

Ultrasonic apparatus can also be used to test billets and other masses of steel, aluminium, brass and other metals. It is employed in impeller wheels, drive shafts and other pieces of machinery which have to stand up to severe strains. Aircraft engineers favor it for testing propellers to check whether internal reinforcements are correctly riveted and oriented. It is particularly useful, too, in locating fatigue failures in moving parts which are in use, such as locomotive axles and crank pins.

Experiments have been made in detecting flaws in concrete. This is apt to be somewhat complicated unless the concrete happens to be unusually homogenous, because echoes may appear at any point where the density varies, but it is quite possible to detect gross flaws under reasonable conditions.

Ultrasonics as a new aid to industry develops almost daily, but its value in the future can, so far, only be guessed.

ELECTRIC BRAIN HAS MEMORY



A pilot model of an "electronic brain"—officially known as an Automatic Computing Engine—is now working at the National Physical Laboratory, Department of Scientific and Industrial Research, at Teddington, Middlesex, where it was designed and constructed. The machine, by the use of radio valves and modern electronic techniques, works at incredible speed and is able to do in one five-hundredth of a second a calculation that would take a skilled arithmetician eight minutes. It also has a memory enabling it to carry out long sequences of operations. The "electronic brain" has already solved some problems, and the Superintendent of the Mathematics Division of the Laboratory is inviting industry to submit more. The "ACE," to be built later, willl be faster and will have increased memory capacity. PICTURE SHOWS:—Left to right: Mr. C. ALWAY, mathematician, at the "input" where the problem is put into the machine; Mr. J. H. WILKINSON, mathematician, at the control panel; and Mr. E. A. NEWMAN, electronic engineer, at the memory and pulse-generating chassis of the "electronic brain" today.

LATEST PLASTIC SPECTACLE LENSES GIVE STRENGTH AND SAFETY

HARDER—MORE DURABLE THAN GLASS

Two steel balls weighing 1¼lb each were dropped on these spectacles, having one glass and one plastic lens.

ONCE upon a time spectacle lenses were considered to be made of glass, and that was that! It was the only material easily obtainable from which good lenses could be made, despite the fact that on many counts it was a poor choice.

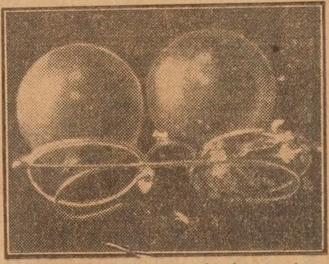
The ease with which glass will fracture has caused injury to the sight of many spectacle wearers, to say nothing of the inconvenience through shattered lenses due to accident.

Now the plastic industry has produced lenses which it is claimed are virtually unbreakable and unscratchable. Plastic lenses are not new, but have always been soft and liable to damage.

The new lenses are 40 times as hard as the old types with an impact resistance several times higher than case-hardened glass.

These lenses have been dropped, walked on, and weigh half as much as glass. They are moulded, heat cured to prevent softening at high temperatures, and may be tinted any desired color. The cost is probably high, as each prescription requires a different mould.

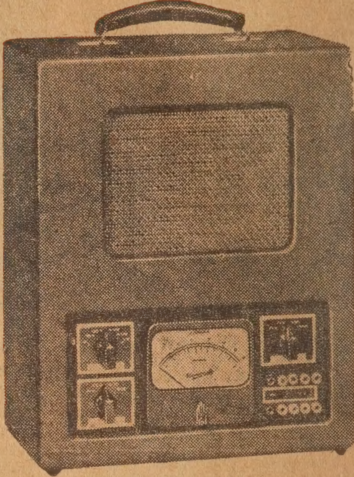
The lenses are likely to have many applications in industry where protective goggles are often used with plain or tinted glass. Their ability to withstand impact and "spatter" should render them most valuable where the risk of broken glass damaging eyesight is a serious hazard.



When the ball struck the lenses, the glass version shattered, but the plastic type was undamaged.

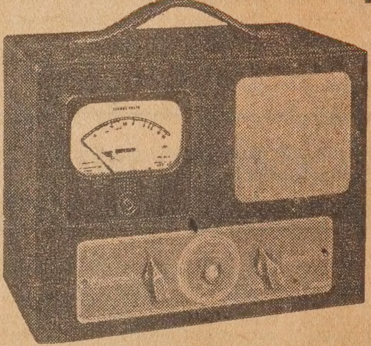
FAST and EASY WORK with these three.

University



Universal Speaker and Output Meter — USO.

This is a much needed and widely popular Radio Service Instrument combining the functions of an accurate calibrated output Meter with a Universal Speaker designed to suit all types of Radio Receivers and Apparatus whether A.C. or D.C. The Meter is calibrated in decimals and watts, and three ranges of 0-500 Milliwatts, 0-5 Watts and 0-50 Watts are provided. The "University" Square Rectifier type Meter is used and it comes complete with book of Instructions and all necessary Leads.



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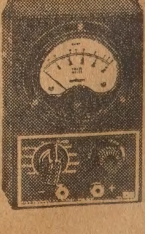

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TOMORROW'S MUSIC MADE OF COLOR

One day in the not so distant future we may go to the cinema to see color films. I am referring not to the color films of today, which are photographs of objects in their natural colors, but symphonies in color which are as "abstract" as symphonies played by orchestras. Symphonies, where the form of the color in relation to actual objects will matter as little as the relation of music to natural and artificial sounds in the real world.

by Professor A. M. Low

FEW people realise that it was more or less a matter of chance whether, in the course of evolution, human beings gained their appreciation of music through their ears or through their eyes.

The sense of rhythm is instinctive, found in the lowest animals and in every main form of life. Perhaps the first appreciation of rhythm in all creatures was produced by the regular rise and fall of tides.

In the course of evolution some animals developed organs particularly sensitive to rhythms in the air —what we now call sound. An irregular tapping on a piece of wood produces noise, but if the taps are spaced at regular intervals and the air is regularly vibrated, it may be sound, or even "music."

A xylophone, after all, is only an instrument for producing fairly pure sounds of this kind.

SOUND RANGES

Many human beings hear only the vibrations produced in the air with a frequency somewhere between 12 a second and 5000 a second. This "wave-band" is but a fraction of possible sounds. In fact, children can hear much higher notes and dogs can appreciate frequencies greater than are audible to any human being.

It is easy to make a whistle that can be heard by a dog but is "silent" for human beings.

Over the course of centuries we have produced a very complicated appreciation of these sounds, singly and mixed, and the result is the art of music. In a similar way we have also built up an appreciation of color.

There is good reason to believe that early animals, like the cat of today, could realise only the presence or absence of color and not its great variety. They saw things in terms of black, grey and white. We have evolved eyes which are able to distinguish far more narrowly between the different light vibrations, just as we have evolved ears able to distinguish between the different air vibrations we call sound.

MEANING OF MELODY

Perhaps only an unbelievably expert musician could distinguish between two tuning forks, one giving 440 vibrations and the other 441 per second, but the great mass of people are able to distinguish between sounds "a quarter tone" apart and thus hear melody.

So with light. It is estimated that a well-trained eye can distinguish between something like 100,000 different colors or "shades" which, of course, is far more than the range of frequencies produced, even by a full ochestra.

The ordinary person could, perhaps, distinguish between half this number of colors. Even this represents only a small fraction of the "possible" colors.

The shortest light waves that can be appreciated by the eye are those we call violet—15/100,000,000ths of an inch long. The longest are 30/100,000,000ths of an inch. Obviously, between these two ranges there are millions of minute differences.

COLOR AND SOUND

In addition, there are theoretical reasons for believing the evolution of the eye is not complete and that, as we have come from the black and white stage of the cat to our present sensitivity, so we may go on to the point where we sense not four primary colors, but over 100.

There is no doubt that certain sounds are associated with various colors. It is no accident that many famous pieces of music have "color" names; heavy chords are generally thought of in terms of sombre colors.

Many experiments have been made to determine the reaction of the average person to sound and color in combination; it is now well established that the human brain has become more sophisticated in its demands for pleasure. Simple primary colors please primitive peoples.

Town dwellers demand not only subtle shades in color, but color also as an accompaniment to their entertainment, particularly dancing and theatricals.

The various colors are just as capable of being built up into "music," with melody, harmony and rhythm as is sound. Indeed, it was more or less an accident that we chose sound rather than color for our music. Color "music" can appeal to the eye as sound music appeals to the ear.

At various times attempts have been made to introduce performances of color music. In the main, they failed because they could rely only on placing the colors side by side or by using prisms which did not give any blending or evaluation of each color note.

They were, therefore, as crude as a native orchestra, and did not, sufficiently entertain the civilised color sense.

The possibilities of color music have long fascinated artists, and a large number of experiments have been made in attempts to discover how colors could be produced at will by a musician.

It seems clear that the desired effect of blending could never be obtained by the aid of solid screens and prism effects, however complicated, and that liquid color is the only possible solution. This is the principle of the latest discovery, a color organ.

COLOR ORGAN

The actual instrument is very small and consists of a glass screen over which a thin film of water can be made to flow. This screen need be no larger than a penny and is placed almost immediately opposite the source of light in a position equivalent to the gate of a cinema projector. Surrounding the liquid constantly moving screen are tiny color containers, each providing its own spectrum color — violet, indigo blue, green, yellow, orange and red.

Each container is operated electrically by a valve connected to keys like those of an organ. The actual drive is by compressed air. By playing on these spectrum colors it is possible to project not only any colors for any desired length of time (the rhythm), but also any combination (the harmony and melody).

The colors can be thrown on to a screen, but a different type of display can be obtained by directing the color beams on to forms, human forms or a wall. At the touch of a key a bowl of flowers can be iluminated with invisible light so that the flowers appear to stand out against darkness in color, which can be changed at the flick of a button.

SMALL SIZE

The keys can be operated by a color musician or by a record which would repeat any pre-determined rhythm of color. Color response can also be obtained automatically from definite musical notes.

The apparatus is minute. A valve no larger than a pin gives the effect

(Continued on Page 19)

Fire is the major enemy of an oil well. The intense heat and explosion danger calls for special techniques in fire fighting. One method is to literally blow out the flame with dynamite.

PETROL POWER WITHOUT PING

"Knock and Ping" is not the name of a Chinese trading firm. The two words are peculiar to this modern age of high compression engines and medium grade petrol. **Calvin Walters explains why your engine is likely to knock when pulling hard up a long hill.**

by Calvin Walters

IF we were to search for the earliest mention of the use of a petroleum product we would find it in the Bible in the sixth chapter of Genesis.

Here, Noah was commanded to make an ark of gopher wood. "Rooms shalt thou make in the ark, and shalt pitch it within and without with pitch."

It is a long time from Noah to the present, but throughout that long period there has been evidence that petroleum products of some kind or another were used by man.

The Pharaohs of ancient Egypt used some kind of natural grease to grease their chariots. This was most necessary as these fellows, for the time in which they lived, must have been reckoned as the world's speed maniacs, careering as they did, hither and thither in the most reckless fashion.

These Pharaohs even found a way of preserving bodies by embalming them in pitch.

History has it that the ancient Persians located their temples around vents in the ground from which issued natural gas. They set fire to this gas, and it was this fire that the Zoroastrians of Persia worshipped as the eternal fire.

The Chinese can't be left out of the story either. This race seems to bob its head up in all kinds of unexpected enterprises and they have been credited with being the originators of a lot of things which we have today.

It is not strange, therefore, that we hear of them about 2000 years ago heating and lighting their houses with natural gas carried through bamboo pipes.

The walls of Babylon were supposed to have been held together by means of pitch.

INDIAN OIL

Hundreds of years before the white man came to America, somebody had been digging wells and getting oil. No one knows who they were. Nobody knows what the oil was used for. These wells had been abandoned long before the white man came there and to this day no idea has been gained as to the identity of the oil getters.

The Indians, of course, were using oil when the first white man visited the American continent. These interesting people collected the oil from springs and "scraped" the surface of pools upon which the oil was floating. They probably burnt the oil in flares and lamps and got better results than from the fat of boiled-down scalps.

It has been recorded by a French missionary in 1627 that the Indians called the oil Antonotons. This means, "Oh how much there is of it." The Americans seem to have adopted this slogan today for just about everything.

So we come down through the ages to the present oil-conscious world in which by good luck we manage to survive.

The story of petroleum is a romantic one, but it is my intention to touch upon merely one aspect of the matter and one which, to my mind, had had the most far-reaching effect upon the design of internal combustion engines. I refer to the discovery of high octane fuel and the development of the high compression modern motor car engine.

Now, most people have heard the word "octane," used. Not too many, however, have a clear idea of what it actually means.

Most users of motor vehicles know that such and such a petrol is "crook" to their way of thinking and their engine knocks when using it. They also say that this or that petrol is anti-knock because it contains "tetra ethyl lead" or benzol. Why these substances minimise "pinging" is not clear to everyone, so I propose to clear up the matter to some extent and to detail just how this anti-knock business came about.

Up to the year 1922, the knocking which was evident in the cars of the day was quite a mystery. All manner of theories were advanced. The carburettor was at fault. The battery was blamed. The oil, the fuel and everything else connected with the car.

This knocking or "pinging" was most in evidence when the car was pushed to the limit on heavy load.

MIDGLEY'S IDEA

Then one day in the workshops of an engineer, Charles F. Kettering came a lad named Tom Midgley. Kettering made Delco engines, which were used to run farm lighting plants. These engines used kerosene for fuel and did quite a lot of knocking.

Midgley was an inquiring youth, and noticed that when petrol was used as a fuel the knocking was minimised, or stopped altogether.

Here was an idea. Could the knocking be caused by the type of fuel used?

To see the better what was happening inside the motor cylinders, Midgley bored a hole into the cylinder head and inserted a quartz window through which he watched the explosions of the gas.

When petrol was used as fuel, the flame in the cylinder was blue, but when kerosene was used the flame was white.

As things turned out, this color of the flame had nothing to do with the matter, but, like so many discoveries, it led to the ultimate solution of the matter in a most remarkable manner.

FLAME COLOR

Midgley thought that the color of the flame must be important, so he sought in the workshop for some oil soluble dye that would turn the kerosene a darker color, thinking that in some way a dark color would absorb more heat and so prevent the knocking.

By good fortune, there was no oil soluble dye available but, as a tryout, some iodine crystals were dissolved in the kerosene and, lo and behold, the knocking of the engine stopped when this was used as fuel. Later experiments proved that color had nothing to do with the matter, but that some peculiar property of iodine had the desired effect.

The use of iodine as a commercial propostion was impracticable, because of the expense and for various health reasons. With the knowledge that the addition of a substance to fuel had the desired effect, experiments were carried out to find other substances which could be used commercially.

Thousands of experiments were carried out and finally a substance was made by subjecting metallic lead to the action of a gas. This resulted in a colorless liquid known today throughout the world as "Tetra Ethyl Lead." It was the most outstanding discovery of the day.

LEADED PETROL

The materials for the manufacture of this substance are cheap and in plentiful supply.

This was only the beginning for Midgley, for he found that the compound left a deposit of lead oxide on the inside walls of the engine cylinder. This was not good for the motor.

How to overcome this is a prime example of the tenacity of the true inventor.

After many painstaking experiments—the magnitude of which would have discouraged all but the stoutest hearts, Midgley found that bromine added to the lead compound prevented the formation of the deleterious lead oxide.

But bromine was a comparatively rare commodity and certainly could not be obtained in anywhere near the quantity to treat the millions of gallons of petrol used throughout the world.

So Midgley and his colleagues went to sea in a ship they called the Ethyl, in order to test the possibilities of extracting bromine from sea water, thus providing an inexhaustible supply of the precious chemical.

The results exceeded all requirements. A large chemical company erected a plant to extract bromine from sea water and today it is said that eighty per cent of the bromine manufactured in America goes into the production of tetra ethyl lead.

It now became necessary to explain to the incredulous public and prospective purchasers of the idea just why the addition of this substance or any other substance for that matter, prevented the knocking.

Accordingly, with the assistance of a large motor organisation, Midgley and his colleagues made large windows in engines and, by means of slow motion moving pictures of the burning of all kinds of fuels, the reason for the knocking was apparent.

When a fuel like petrol is vaporised in the carburetter of the car, it is sucked into the cylinder head and there compressed by the action of the piston in the cylinder.

COMBUSTION SPEED

After compression, the spark occurs in the spark plug, and the vaporised petrol and air mixture ignites and expands, thus forcing the piston down and supplying the motive power to the crankshaft.

When the petrol ignites the flame travels through the gas more or less gradually, beginning at the point of spark.

At the point farthest from the spark plug, however, the petrol at times explodes spontaneously, because of the pressure, and thus "goes off" before the flame had time to reach it. This causes the objectionable knocking. The engine "fights itself," so to speak, and loss of power and overheating results.

The addition of tetra ethyl lead slows down the rate of combustion and spread of the flame and the piston is pushed down with an even thrust without loss of power and creation of surplus heat.

It now became necessary to devise a scale by which the anti-knock qualities of various fuels, with which

(Continued on Page 19)

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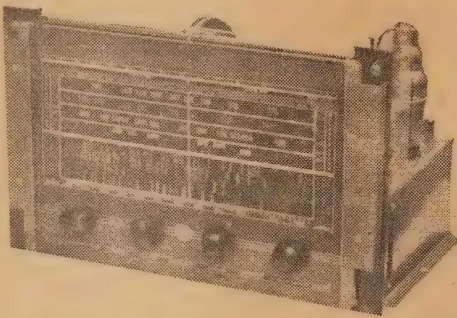

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Technical Review

OVERTONE CRYSTALS SIMPLIFY VHF WORK

Quartz crystals can be made to operate directly on odd overtones up to 150mc, with high power output and better stability than the crystal would normally have at its fundamental. The technique involves shunting the crystal with a proper value of inductance and tuning the plate tank for the desired overtone frequency.

THE increasing use of frequencies above 30 mc for limited-range communication and control purposes means that closely-spaced channels are needed to provide for the many services that would like to use these frequencies. This close spacing, at least at the present state of the art, requires crystal control to provide the required carrier frequency stability.

Crystals can be ground to operate on fundamental frequencies as high as 30 mc. The Bureau of Standards has, in fact, processed crystals to 100 mc, but their commercial manufacture is probable only at some much later date. Making crystals physically thinner presents so many problems that some other means was sought for producing high frequencies directly from lower-frequency crystals.

The goal was to find a circuit-operating technique that in effect would slice a crystal electrically into the desired thinner plates, so that thick crystals could be made to vibrate with adequate power output at values much higher than their fundamental frequency. The development to be described achieves this goal by utilising in a unique way the presence of overtone activity in certain types of quartz crystals. Overtone activity, to be described, should not be confused with operation as a frequency multiplier, wherein the plate tank is tuned to a harmonic of the fundamental.

NATURE OF OVERTONES

Many crystals, particularly BT and AT cuts, exhibit strong overtone activity wherein the crystal appears to consist of layers of active material operating in shear modes, with opposite outside faces going in opposite directions, as shown in exaggerated form in Fig. 1. For the third overtone the crystal acts as if it has three equal layers; for the fifth, five layers; for the nth overtone, n layers, where n is always an odd number. The thickness of each vibrating layer is approximately 1/nth the thickness of the crystal at its fundamental.

Overtone crystals (improperly called harmonic crystals) have been on the market for some time, but most of these utilise the third overtone (generally around 30 mc), because higher-order overtones could not be developed by conventional circuitry. Investigation showed, however, that almost all carefully processed AT or BT-cut crystals exhibit activity on higher overtones such as the 5th, 7th, 9th, 11th and 13th. Many crystals even show activity at the 23rd overtone, and a few have actually indicated activity on the 29th overtone, which for a 10-mc crystal would be around 290 mc.

Crystal Oscillators Advantage of Overtone

Direct crystal control up to 150 mc with 10-mc or lower-frequency crystals.

Overtone frequency is only frequency present in circuit, hence no spurious radiation.

Direct frequency modulation is possible and practical, including carrier-frequency shift by d-c for keying or telemetering.

Temperature-frequency stability better than crystal itself.

Excellent voltage-frequency stability even up to 70 volts plate voltage change.

Vibration and severe jarring do not affect frequency.

Higher efficiency and much smaller vhf and uhf equipments, reducing battery drain and weight of mobile units.

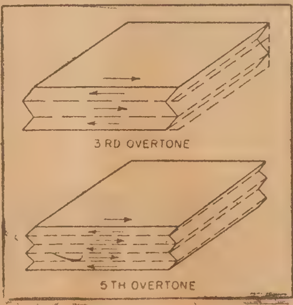

Fig. 1—How an overtone crystal works. The crystal acts as if electrically sliced into odd number of layers.

The overtone frequency of a crystal is not an exact multiple, or harmonic, of the fundamental. Harmonics can only be obtained electrically, whereas crystal overtones are the result of pure mechanical vibration. The frequencies of overtones approach corresponding harmonic values but are either higher or lower by an unpredictable amount. For this reason, overtone crystals are ground to the desired overtone frequency and marked with that value, the fundamental being ignored.

An analogy is the string of a piano, which vibrates over its entire length to produce the fundamental note and over the shorter lengths to produce overtones. The frequencies of these musical overtones are close to corresponding harmonic values but not equal to them, as any musician will testify.

It should also be pointed out that a crystal will vibrate at only one overtone at a time. The overtone at which it vibrates depends on the resonant frequency of the circuit of which the crystal is a part.

Overtone crystals are ordered to

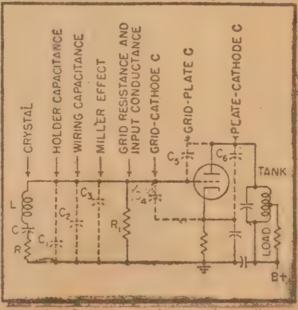

Fig. 2—Conventional crystal oscillator circuit drawn to emphasise the important elements affecting crystal operation.

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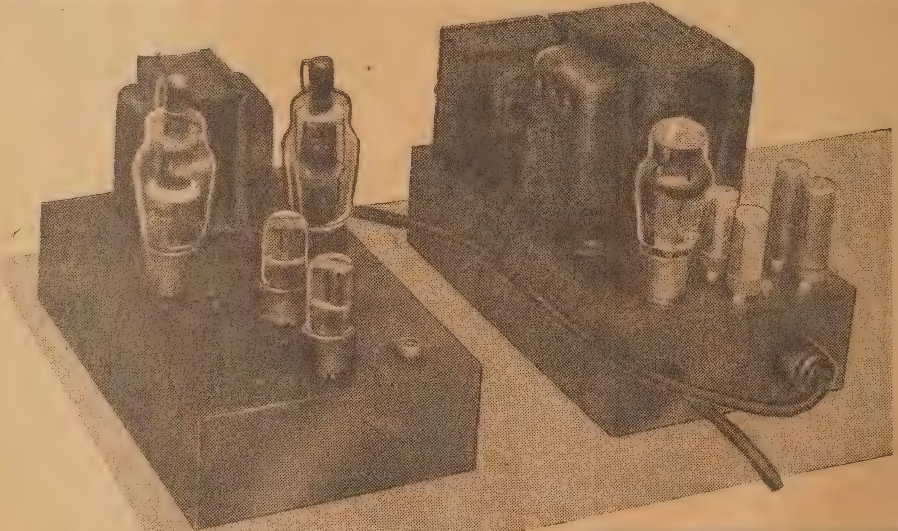

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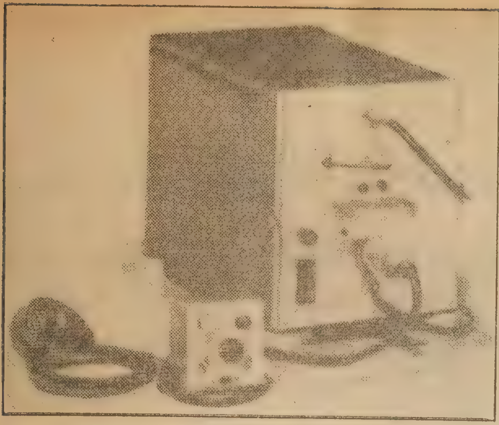

- Example of 460-mc mobile unit using overtone crystal oscillator.
- Developmental model shown delivers 22 watts frequency-modulated output at 468-.72 mc with plus over minus 10-kc carrier stability. Total current drain from 6-volt battery is 10 amp for receiver and 31 amp for transmitter. Total weight is 43lb.
- Transmitter crystal with fundamental of approximately 8.68 mc operates directly on 78.12 mc, which is 9th overtone. Reactance modulator for oscillator is driven by single a-f stage. Following crystal is low-power neutralised 6C4 isolating amplifier and 832A tripler stage with long-line plate tank coupled by balun to 4-150A final stage operating as doubler in cavity with 550 volts at 90 ma. Deviation is plus over minus 25 kc, with automatic deviation control. Audio fidelity is within 2 db from 60 to 10,000 cps.
- Overtone crystal oscillator in receiver operates at 76.46 mc and is followed by 6AK5 six-times multiplier to get ample injection voltage for mixer. Grounded-grid amplifier stage precedes mixer; following it are three 10-mc i-f stages, limiter, discriminator, squelch circuit and final audio stage delivering 0-8 watt output. Sensitivity is better than 1 microvolt for complete limiting.

an exact frequency, which is the frequency at which the electrical reactances of the crystal are equal and opposite and thus cancel. This frequency value is the true overtone value of the crystal alone, without holder or circuit. The circuits referred to operate at frequencies slightly removed from this series resonance value.

The accompanying diagrams show how the crystal is used.—Electronics.

PROJECTION v. DIRECT VIEWING FOR TELEVISION

A discussion took place at a recent meeting of the I.E.E. in England which brought out some interesting views of engineers concerning ideas for bigger and better screens. Significant is the fact that there was universal approval for the use of a larger picture.

AN informal discussion on the above subject was opened by W. T. Cocking, who gave a short introductory talk to bring forward some of the relevant points at issue.

The first, which occupied the meeting for a large proportion of the time, was the question of desirable picture size. Many speakers were of the opinion that we need bigger pictures than are at present given by the average television receiver, and it was suggested at the outset by a representative of the BBC that the most suitable size would be about 20in. by 15in.

At the usual home-viewing distance of about 8ft this would subtend a viewing angle of 10 degrees, corresponding to a back seat at the average cinema, and would be such that the line structure on 405-line definition would be not quite discernible.

CLOSE UP SHOTS

One argument put forward for this order of size by an advocate of projection television was that television producers would not be so limited to close-up shots as they were at present. Other speakers thought that the large picture was more restful to the eyes, which had freedom to move about over it, but this opinion was disputed by two supporters of direct-viewing.

Apart from this, the question of size did not provoke a very sharp division of opinion, since both sides were more or less agreed on the desirability of big pictures. There was, however, some argument on the relative merits of projection and direct-viewing tubes for producing these big pictures.

CHEAPER TUBES

The opinion was expressed, for instance, that really large direct-viewing tubes could not possibly be mass-produced at low prices, and so installation and replacement costs would be too high. Moreover, although there were no official figures on the lives of projection tubes—nor on direct-viewing tubes, for that matter—there was no evidence to show that they had shorter lives.

In reply to this, it was stated that manufacturers are hoping to produce 20in. tubes at lower prices within a few years, and that, although projection tubes were certainly small, they could not be produced cheaply because of the large amount of precision work involved.

Several speakers referred to the use of front projection on to reflecting screens to obtain even larger pictures, but it was pointed out that the optical focus would be upset by any alteration in the position of the screen and such a system would always necessitate a darkened room.

On the subject of optimum viewing distance, several speakers agreed that this had less to do with the size of the picture than was generally thought. A representative of the BBC said it was the absolute size of the picture that was important subjectively, not its apparent size due to different viewing distances.

Mr. Cocking had stated that the optimum viewing distance for a projection picture 14in. wide was about 10ft, and had suggested that for this reason the public might be disappointed with projection television in the home where the convenient viewing distance was limited to about 6 or 8ft. Commenting on this, a speaker thought that figures for optimum distance could not be relied upon, as he found that it was a matter of personal preference and different people selected different distances.

VIEWING DISTANCE

This opinion was supported by several others, who quoted various distances, ranging from 3ft to 9ft, taken up by people when viewing. In reply, Mr. Cocking stressed that his figure of 10ft was obtained from tests in room without chairs, so that people were not influenced in any way by the existing seating arrangements.

Several speakers were of the opinion that although the directivity of projection television was a help toward good brightness, more could be done by improving the optical system, which was stated to be only 4 or 5 per cent efficient at the moment.

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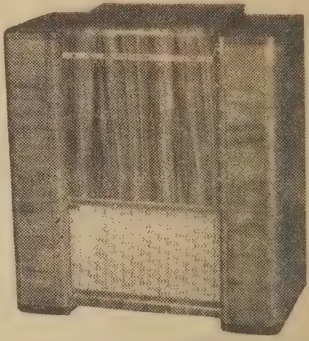

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PETROL POWER WITHOUT PING

(Continued from Page 13).

tetra ethyl lead was mixed, could be compared.

A scale was worked out by Graham Edgar, of the Ethyl Corporation, which he called the "octane scale." This scale was based by taking the fuel known to have the least knocking properties and calling this 100. The worst knocking fuel known was called zero. If then, for instance, a mixture of the two was made in the proportion of 70 per cent of the 100 fuel and 30 per cent of the zero, the "octane" rating would be 70.

Thus, a collection of fuels of known octane rating was made. All fuels were tested in a single cylinder engine and this came to be the universal standard.

MORE POWER

For many years before the discovery of anti-knock substances engineers knew that more power could be obtained from a motor by increasing the pressure to which the gas and air mixture was subjected in the cylinder head.

The engine could not be used, however, because immediately the compression was increased the knocking became evident and the value of the higher compression was nullified.

The advent of Midgley's tetra ethyl lead solved the problem at one stroke. The immediate effect was the production of high compression motors, which are fitted to all modern cars at the present time.

It has been found that the largest amount of tetra ethyl lead which can be added to one gallon of petrol is three cubic centimeters. More than this creates a health hazard and reduces the effectiveness of the fuel.

During the war other means were sought for increasing the effectiveness of fuels for aeroplane motors.

Chemists got to work and discovered that the anti-knock qualities of petrol were some way dependent on the arrangement of the molecules.

They found that when the carbon atoms of a molecule of petrol are arranged in a straight line the fuel produces a bad knock.

GROUPING

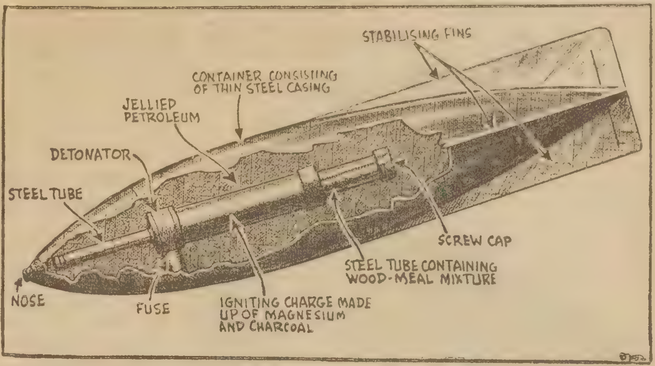
If the atoms are grouped together and arranged each group one on top of another, the fuel will not knock and much more power is obtained.

These discoveries have opened a very wide field in the refining of petrol and the hidden reserves of a gallon of petrol are gradually being tapped. Scientists tell us that there is a potential 250 miles in every gallon of petrol used in a modern car.

By means of catalysts in the "cracking" process of crude oil, new high octane petrols are being produced. In fact, some of the aviation fuel made during the war was rated at over 100 octane.

At the present time the cost of this high grade fuel is prohibitive. It is only for war purposes where cost does not matter. As long as we can waste in this manner the cost no matter how high, is negligible.

JELLIED PETROLEUM BOMB


STABILISING FINS
CONTAINER CONSISTING OF THIN STEEL CASING
JELLIED PETROLEUM
DETONATOR
STEEL TUBE
SCREW CAP
STEEL TUBE CONTAINING WOOD-MEAL MIXTURE
NOSE
FUSE
IGNITING CHARGE MADE UP OF MAGNESIUM AND CHARCOAL

One of the devastating weapons of air attack is the jellied petroleum firebomb. During World War II incendiaries of this type were used extensively by Allied countries and by the enemy. In Korea recently, General MacArthur's UN Forces, includng Australians, have made telling use of this type of missile in attacks on North Korean convoys, tank columns and installations.

In Korea, "Mustang" single-seat fighters have been used to launch the attacks with these firebombs, the bombs being carried externally, mounted under the wings.

Early in the Korean fighting, General MacArthur reported in communiques use of "napalm" in air attacks. "Napalm" is the term used in the USA for the jellied-petroleum bomb or incendiary container. One such bomb is illustrated in diagram form in the accompanying illustration.

In the production of "napalm," a chemical thickener is added to petroleum to convert it into a semi-solid of jelly-like consistency.

Bombs of anything from 100lb to 500lb are made up with "napalm."

As can be seen from the sketch, the bomb has a thin steel case. It contains an explosive detonator in addition to a fuse and igniting charge.

On impact with the target, the bomb bursts and fiercely-blazing jelly is hurled in all directions.

The flaming jelly adheres to anything it strikes, generating enormous heat as it burns.

Use of napalm bombs is particularly effective against lorry convoys and buildings. The bombs are also a telling weapon against tanks, for even the heaviest armor does not make them immune to the firebomb's effects.

By clinging to the outside of the tank, the burning jelly can cause unbearable heat within, and so lead to abandonment. Should it seep into the interior, it may cause the tank's complete desruction by exploding the vehicle's fuel tanks.

Tactical use of the napalm bombs is by low-level attack against pin-pointed targets.

TO-MORROW'S MUSIC MADE OF COLOR

(Continued from Page 11)

of a shimmering snowstorm on a building by injecting on the glass screen a trifle of aluminium paint. But the "snowstorm" through the light beam could embrace the whole of Buckingham Palace and be of any color, shade or localised color.

In practice, and on a full scale, the effect is like that of a giant provided with enormous brushes working on a great canvas, stippling or splashing a corner of a building or "washing" the whole surface in a fifth of a second and then changing to another color in the same way.

Parts of the screen can be colored in a variety of colors by light, quick touches on the keys, and depth is controllable by "base" keys exactly as in the case of sound music.

Our imaginary giant could wash a building in an instant with one color, gradually edging it away with others if he wishes, or in another, alter the whole set and build into it color pictures and tones just as a musician would play a sonata on the keys of the finest organ in the world.

A new art has certainly been born; it has immense and very beautiful opportunities.

RECORD PLAYER
★ DUO-SPEED
★ HIGH FIDELITY

Goldring

GOLDRING PRESENTS A RECORD PLAYER which will never become obsolete whatever speed may ultimately be used for DISC RECORDING.

ITS MAIN FEATURES ARE:

- The GOLDRING THREE-WAY PICKUP (No. 150) regarded by many experts as the greatest advance in pickup design.
- A DUO-SPEED MOTOR FOR STANDARD (78 rpm) and LONG PLAYING MICRO-GROOVE (33 1/3 rpm) records.
- BEST QUALITY LEATHERETTE Covered Case can be closed when playing 12" records.
- Independent on-off switch.
- EASY PLUG-IN TO MAINS.

THE GOLDRING THREE-WAY PICKUP (No. 150)

HIGHEST FIDELITY REPRODUCTION.
Easy change from 78 rpm to 33 1/3 rpm by simply changing color coded stylus and moving weight adjustment.

OUTPUT : 150 mV.
FREQUENCY RANGE : 30—16,000cps
STYLUS PRESSURE : 14 grms (78 rpm)
: 7 grms (33 1/3 rpm)
OPTIMUM LOAD : 50,000 ohms
SAPPHIRE STYLI (supplied with PLAYER)
BLUE : 0.003" for Standard Records
YELLOW : 0.001" for 33 1/3 rpm Records
REPLACEMENT STYLI : 15/- each.
Also available GREEN : 0.0025"
ORANGE : 0.0035"

THE DUO-SPEED MOTOR

Ideal for playing both standard and long playing records.

Rim driven 4 pole motor of advanced design assures low rumble.

No stray field radiation.

Uniform turntable speed.

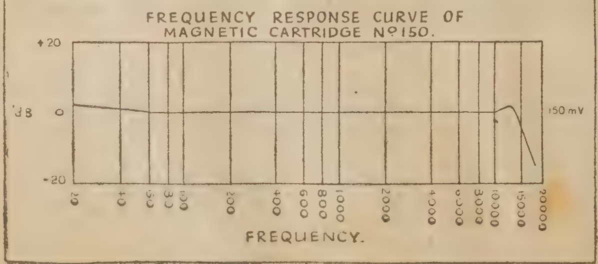
Instantaneous speed variation (wow) at absolute minimum.

Self lubricating bearings ensure quiet running and long life. Need no oiling.

Speed change from 78 to 33 1/3 rpm effected in a few seconds by merely reversing main pulley drive.

10" HEAVY PRESSED STEEL TURNTABLE
Supplied connected to 200/250 volts but change to 100/125 volts is accomplished easily.

PLEASE NOTE: The unique design of this PICKUP using stylus as ARMATURE does not permit use of other styli or needles. 45 rpm RECORDS when available will be played with same stylus and weight as 33 1/3 rpm records.



FREQUENCY RESPONSE CURVE OF MAGNETIC CARTRIDGE Nº150.

Should records using any other speed become available, adaptors will be supplied at small extra charge.

Design of suitable pre-amplifier and equaliser supplied with each player.

Price £17/15/- (Inc. 25% Sales Tax)

(Interstate slightly higher)

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Phone: St. Mary's 447. After Business Hours, UW6907

NEWS AND VIEWS OF THE MONTH

UHF television transmitter

A NEW type of transmitter that will aid in opening additional air lanes for television has been announced by Stanford Research Institute, Stanford, California.

The transmitter has been designed for sending signals in the ultra-high frequency (UHF) region of 475 to 890 megacycles recently authorised by the Federal Communications Commission for experimental television broadcasts.

The new transmitter was developed under the sponsorship of John H. Poole, of Long Beach, California, and is adapted to the needs of his experimental UHF station KM2XAZ at Long Beach.

Now installed, the transmitter operates on 530 megacycles. It radiates an entirely standard amplitude-modulated picture signal of good quality and, it is claimed, does so in a manner permitting the attainment of a very high-powered UHF transmission more economically than by any other present-known system.

While the KM2XAZ transmitter is at present radiating only 150 watts of power it is capable of being amplified to powers in the tens of kilowatts using relatively simple radio-frequency amplifiers. This is achieved by applying for the first time to television a system of modulation known as "phase to amplitude."

The phase-to-amplitude modulation system reaches high power levels with presently available UHF tubes which are difficult to amplitude-modulate by any other means. The special transmitter can also make use of the recently developed "unorthodox" tubes such as klystrons, resnatrons, and travelling-wave tubes.

The heart of a transmitter of the new type is the phase-modulator unit, which serves to advance the phase of one of the two signal channels of the system by exactly the same amount that it retards the phase of the second channel. A unique arrangement of conventional UHF tubes has been employed to perform this function satisfactorily.

Still another innovation in the institute's work on the transmitter has been the development of a vacuum tube which does the modulation job of several conventional tubes in one. Several models of the special phase-modulator tube have been built and tested. Thus far these tubes have had the limitation of low power output. If they can be developed to the point of operation at higher power levels, staff engineers believe the complexity of the phase-modulator unit can be greatly reduced at the same time its performance is improved.

Perfection of a transmitter of the type announced has been one long-sought step toward the opening of the UHF region for commercial broadcasting. Another is the development of converters for bringing UHF signals down to the VHF (very high frequency) level of standard commercial receivers. Last year such a prototype converter was designed and built at Stanford Research Institute under Mr. Poole's sponsorship. It employed novel circuit techniques that have attracted widespread industry attention. The converter has since been modified to include several tuneable versions.

Atomic detectors

THE use of radio-active material in military activities is underlined by the development for the US Army of a small detector unit, worn around the neck and capable of indicating when the wearer is subject to unsafe radiation.

A sensitised film is used which reacts when radiation of too great an intensity is met. Only short exposures are necessary for definite indications in the detector.

Better airscrews

THE aircraft airscrew, or propeller as it is widely termed, has been developed according to overseas report to enable its use at much higher speeds than previously were thought possible.

Limitations of power loading and tip velocity have led to the general idea that about 500 mph was as high as designers could go with airscrews and about 3500 hp the top loading for any one unit.

The Curtiss-Wright corporation in America now reports a considerable advance in their new airscrews and hopes to produce types which can be used up to 1000mph and absorb up to 20,000 hp.

It is unlikely that they will be used for straight piston engines, however, being more suited to the turbo-jet engines which still appear to lead pure jets on a commercial basis. The jets are still too heavy on fuel for economy in many services.

The propellers bear little resemblance to early types, having rectangular-shaped blades.

Australian record

THE month's highlight in the recording world was the recording of John Antill's Corroboree by Columbia.

There have been very few full orchestral records made here in Australia. Such records to return a full sale must compete with those of famous overseas orchestras, and even if the performance were comparable it is doubtful whether the Sydney Symphony Orchestra would read better on a label than, say, the London Philharmonic.

It's not the easiest thing in the world to record successfully a big orchestra. The results are not always what they might be, as samples from current lists will show. Some on the other hand are exceptionally fine. Not the least of the difficulties encountered is the necessity for housing a round 100 players in a hall which has just the right amount of liveliness, sound distribution, and size.

Corroboree was made in the Ashfield Town Hall, Sydney, on one of our hottest days. It was selected because of its acoustics and availability, but unfortunately it is situated in the heart of a busy suburb. Startling although some of Antill's effects may be, they could probably not reconcile themselves to the rattle of a passing tram or the honk of a bus horn.

Soundproofing meant hermetically sealing the hall to exclude sound, and, incidentally, air. Few of the players will forget the experience in a hurry.

However, despite all the difficulties, we believe the recording went well. Discs should be available early in the new year and are bound to be well received all over the world.

What's the time?

IT'S not much use asking this if you live in Sydney and have electric clocks in your home. One effect of the constant blackouts is that all the electric clocks have stopped each time the power has been switched off. When this has occurred during the night hours John Citizen has received rude awakenings in the morning. Many have not even bothered to start up their clocks, knowing that it was only a matter possibly of hours before the darn things would be stopped again.

It's a rather sober thought that the more we electrify our lives the more they will be disorganised through power failures.

Until continuity of current is something as dependable as the sun one can't blame housewives and others for thinking twice before placing their complete heating, lighting and cooking facilities at the mercy of the power houses.

Electric bells

MANY churches these days have fitted into their steeples and spires sound amplifying equipment designed to simulate a peal of bells.

This can be quite a good idea and an effective one if properly used. One or two examples have come to our notice recently where the effect was far from good. Whether the amplifiers, speakers or recorded material were at fault we have not established, but frankly we were quite glad when finally we were out of earshot.

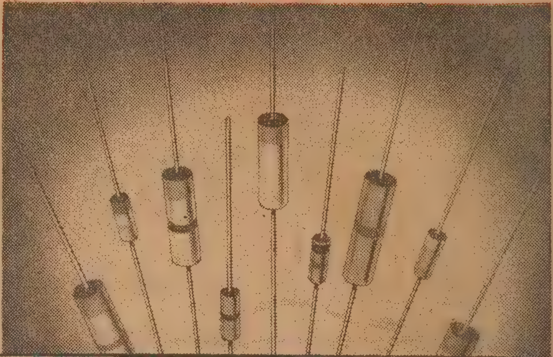
MORGANITE RESISTORS

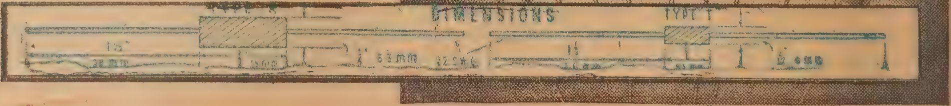
TYPES T and R

These moderately-priced BRITISH Resistors combine high performance with unusually small size. They are made accurately to their stated resistance values and are consistently stable.

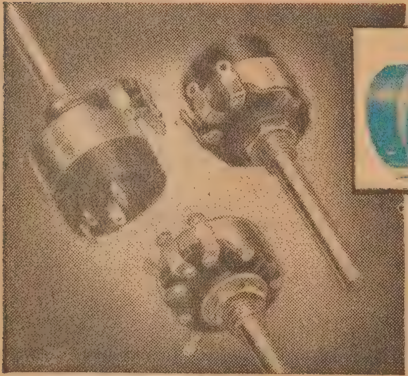
The simple construction of Morganite Resistors provides small, robust, light weight components of high power dissipation and low operating temperatures, and are colour coded to RMA Standard.

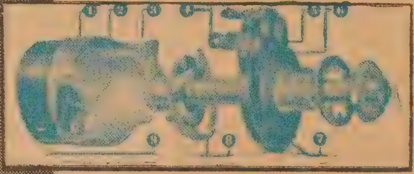
Stocked in preferred Standard values, viz., 10—12—15—18— etc., values rising in 20 per cent steps (approx.). Morganite Resistors Preferred Value Ranges are standardised in U.S.A. and U.K., and are now available in Australia.





MORGANITE MINIATURE POTENTIOMETERS





New in design .. British made .. and fully incorporates the traditional Morganite standard of quality.

Radio engineers will appreciate not only the small compact size of the Morganite Potentiometer, but the fact that it is available with a single or double pole switch of proved Morganite reliability.

SPECIFICATIONS

1 Overall diameter 1 1-8".
2 Double pole or single pole switch operated from shaft.
3 Pressure diecast rotor and shaft for accuracy and strength.
4 DOUBLE CLENCH TERMINALS eliminate noisy joints.
5 Same track design for switch and non-switch type enables interchangeability. Switch type converted to non-switch by interchanging covers.
6 The renowned MORGANITE RESISTOR TRACK LOW noise, hard wearing, wide range of standard resistance values and gradings. Rating ¼ watt.
7 Standard position fixed tapping available.
8 Double prong SPRING CONTACTS, in special non-tarnishing metal for resistor sweep, maintains correct pressure for minimum noise without wear.
9 The switch withstands the most rigorous operating conditions. Rating: 2 amps, 240 volts.
10 Instrument QUALITY at LOW Prices.

THE MORGAN CRUCIBLE CO. (AUSTRALIA) PTY. LTD.

BOURKE ROAD, ALEXANDRIA, N.S.W.

TELEPHONE MU1371 • CABLES & TELEGRAMS: MORGANITE SYDNEY

The operators of these electronic chimes have just as much responsibility to passers-by and the general public who hear them as the operators of any other public address system. They should be particularly careful to keep their equipment in good order. A really good system can present a very fair imitation of the real thing. But a distorted and scratchy performance is only a nuisance, all the more so when it shatters the peace of a quiet Sunday morning when other forms of public address probably would not be tolerated.

Tape recorders

THE home recording bug is rapidly proving itself to be about as dangerous as the radio bug itself. Apart from discs, which already have a big following, an extraordinary number of enthusiasts seem to be making themselves tape recorders with varying degrees of success.

Our pre-occupation with the handy disc records doesn't mean we are not just as interested in tape, but at the moment it seems that a good deal of improvisation is needed to complete the job, together with neat solutions to many problems.

We'd like to see some of these finished jobs which (a) really work and (b) don't cost too much. Come on, you clever coves! Let's hear from you and your recorders.

Television Screens

SOME interesting comments made at an IEE meeting in England appear on page 17 of this issue, concerning the size of television screens.

Significant point of them all is the universal agreement that at present, screens are too small.

It seems only a matter of time before the restrictions of a small screen will weigh rather heavily against the present small tubes. It is hard to see how much improvement can be made until some radical change takes place in the structure of the cathode ray tube.

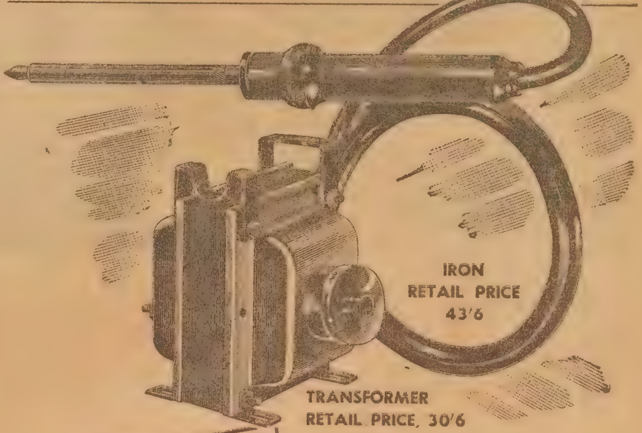
Once the television novelty has worn off, the public will probably become critical of many points about television which at the moment they accept as normal. The small picture is likely to be one of the first.

Is there any real future in the CRT for television display? Many think that some new method will be required before the large screen projection can be realised in practice. Any solution at present can only mean very costly tubes, high voltages and dangerous stresses on large tube faces. All these make mass production, and cheaper production considerably more difficult. Without both, television for every man is hard to visualise.

Irrigation was practised in the Nile River valley more than 2000 years before the Christian era, when great artificial lakes and canals were built to conduct water across barren lands. There have been few basic changes from the methods employed in remote times.

CHECK THESE FEATURES!

- *Operates from 2.5, 6.3 volts A.C. or D.C. or from mains with transformer.*
- *Heats up from cold to ready-for-continuous use in only 6 seconds.*
- *Has an efficiency equal to that of irons rated up to 150 watts.*
- *Weighs only 3½ ounces and is 10 inches long.*
- *Can be used in conjunction with a transformer from A.C. mains or from any suitable car battery.*
- *Has low operating cost—no current is consumed when not in use; no frequent cleaning and tinning of the bit.*
- *Extremely suitable for heavy or delicate soldering—heat is applied only where and when it is required.*
- *Simple to operate — merely press switch ring forward and the iron is hot in six seconds.*
- *Maintenance is simple — elements and replacement tips are fitted easily and without delay. Replacements are screwed in and cost only a few pence.*
- *Fully guaranteed for three months from date of purchase. A maintenance service is available at all times.*



SCOPE

THE SOLDERING IRON THAT
HEATS FOR CONTINUOUS USE IN
6 SECONDS

Scope is a new type soldering iron that gives amazing soldering speeds while operating from low voltages, even on the biggest jobs of work. To really appreciate the value of Scope you should see it demonstrated. It may be connected to a 6-volt car battery or, through a suitable transformer, to 240 volts A.C. To use, you merely push the switch ring forward with a light thumb pressure, and in six seconds the soldering tip is hot—ready for use with an efficiency equal to that given by other irons with ratings up to 150 watts. Scope gives modern efficiency and low cost, long-life soldering. See it demonstrated and you, too, will agree it is the best soldering iron value to-day.

★ ★ ★

You should see and test Scope for yourself. If you do this, you will agree it is the soldering iron you should and must have. Ring, write or call for illustrated pamphlet and a demonstration.

Australian and Overseas Agents:

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Bradbury House, 55 York Street, Sydney. 'Phone: BX 2508.

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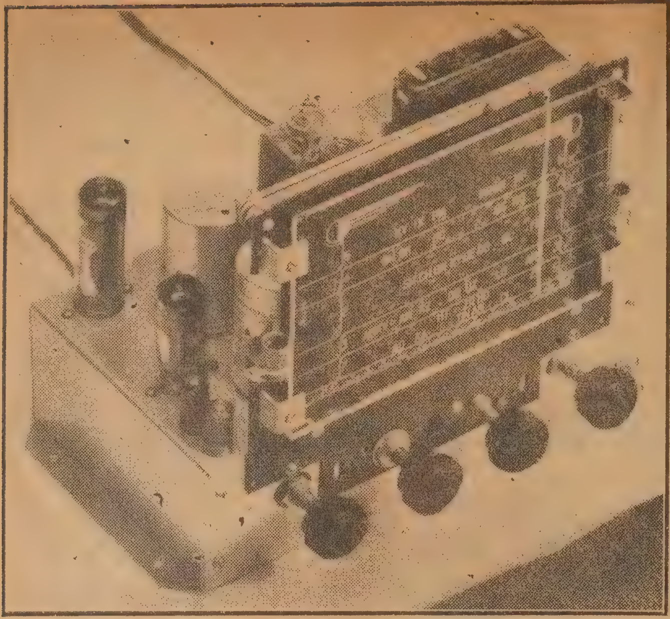


Only a small chassis behind the dial but it packs a real punch. This set is a baby in size only!

An entirely new set!

THE NEW BABYGRAM

If you are looking for a radiogram that won't cost you a fortune to build, here is the ideal design. With only two or three wiring components above the usual three-valve design and some clever circuitry this little set behaves very much like a small superhet. It will bring in all the local stations cleanly and at full speaker volume while the audio channel has sufficient gain for almost any pickup.

by Maurice Findlay

IN last month's issue we published the circuit of the Christmas box mantel receiver. Even in the short time since publication date, we have had dozens of reports from readers who have the set working and are more than willing to share our enthusiasm.

AERIALS

The reports indicate that, with a short length of wire, it is possible to tune all the local stations cleanly and at full speaker volume from any suburban location. For most purposes the set behaves just like a small superhet.

The fixed regeneration works wonderfully in and around the city. It provides the extra gain needed for full speaker volume and sufficient selectivity to enable the local stations to be tuned without a trace of overlapping.

The aerial should be pruned for best performance, but this is no hardship for the average handyman. The idea is simply to make it long enough to give full volume on the weakest local station, but not so long that there is overlapping on strong stations close together in frequency.

In most locations a 10ft length of wire works wonderfully. The set can easily be moved from room to room or out of doors if necessary as the aerial is not long enough to be too cumbersome. Indoors it can be dropped down behind a lounge or run under a corner of the carpet, or, if you feel like some music while sunbaking on the back lawn, the lemon tree will make an excellent support.

If you live outside the metropolitan area, you may easily find that 20 or 30 feet of aerial works best, but five minutes experiment will determine the optimum length for your location. It is a small price to pay considering cost and complexity of a superhet.

Our new set uses essentially the same circuit as the Christmas-box, but includes a switch so that the audio section of the set can conveniently be used to amplify the output of a pickup. With the idea that the new set may be installed in either a mantel or console cabinet, we designed a completely new chassis.

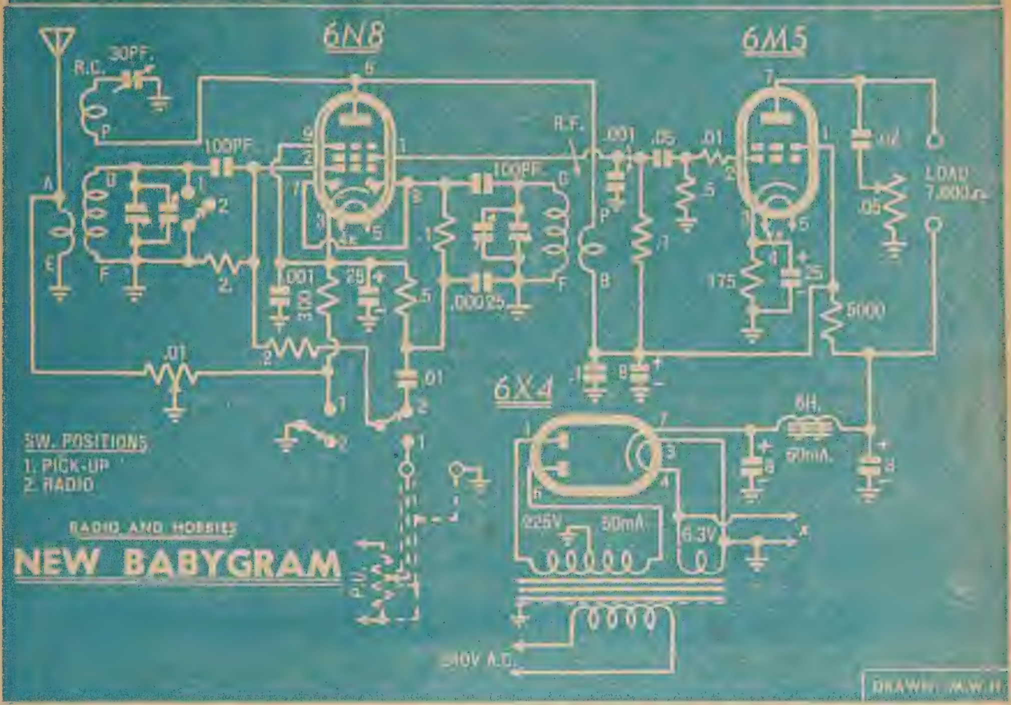
DIALS

If you have a big cabinet you can use a large straight line dial, or a medium-sized straight line dial such as is shown in the photographs is suitable for a table model radiogram cabinet. Where space for a big dial is not available, there is at least one small straight line, station calibrated job avaliable, or you can even use a simple drum dial as was suggested in last month's issue.

In other words the new layout is as flexible as possible. We could quite easily have saved inches on the size of the chassis in all directions, but there is very little point in doing so since ultra compactness would only tend to make the set hard to build and service. As it is, there is plenty of room for everything and most components are accessible without the need for interfering with the wiring.

We will have more to say about the assembly and wiring later, but

CIRCUIT DIAGRAM OF THE NEW BABYGRAM



The circuit diagram shows how a combination of regeneration and reflexing gives the utmost from few components.

the circuit is particularly interesting and even those who read the article in the December issue will wish to refresh their memories.

VALVES

There are three valves, all of which are miniature types with the pins sealed into the glass base. The 6X4, which fits the 7-pin socket, is a power rectifier, and its purpose is simply to rectify the alternating current from the mains so that it is suitable for supplying the other two valves. The 6M5 is a very sensitive pentode designed to drive a loudspeaker, and in this set accepts an audio signal from the previous stage, amplifies it, and passes it on to the speaker voice coil through the appropriate transformer.

Most of the interest centres around the 6N8, which includes a regenerative RF amplifier, a diode detector and a triode audio amplifier in a single envelope.

The radio frequency signal is applied to the grid of the 6N8, and appears considerably amplified at the plate. Most of the amplified signal is passed on to the diode detector, via the RF coil. However, a small portion of the radio frequency voltage at the plate is fed back into the reinartz coil and appears eventually back at the grid.

Control of the amount of RF fed back into the grid is achieved by adjusting the trimming condenser. If you start with the trimmer at minimum capacity and gradually increase the feedback, you will note how effective the feedback, or regeneration, is in improving both the gain and selectivity.

REACTION

A point is eventually reached when the feedback becomes so great that the valve breaks into oscillation. It is just below the point of oscillation that gain and selectivity are best.

The audio frequency output of the diode detector is fed back into the grid of the 6N8 in parallel with the original radio frequency signal and the valve amplifies the two signals simultaneously. To simplify the circuitry and reduce the number of components, we have arranged things so that the valve works as a pentode for radio frequencies, but only as a triode for audio frequencies.

The audio frequency voltage appears across the .1 megohm resistor which serves in the dual role of screen dropping resistor for the pentode and plate load resistor for the triode. As far as the pentode is concerned, the screen is effectively by-

PARTS LIST

1 Chassis 8½" x 5" x 2½".
1 Power Transformer, 225V 50mA. and 6.3V 3A.
1 Filter Choke, 7H. 50mA.
1 Speaker with 7,000 ohm trans.
1 Tuning Condenser, 2 gang midget.
1 Dial.
1 Reinartz Coil.
1 R.F. Coil.
3 Miniature Sockets (2 9-pin, 1 7-pin).
1 Carbon Potentiometer 10,000 ohms.
1 Carbon Potentiometer, .05 meg.
3 Trimmers, 30 pf.
1 Rotary Switch, 3 pole 2 position.

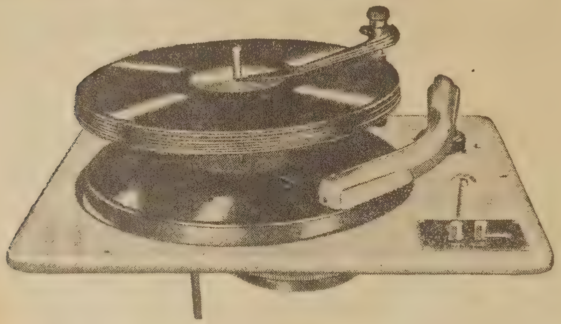
CONDENSERS.
2 25 mfd. 40 volt.
3 8 mfd. 525 volt.
1 .1 mfd. 400 volt.
2 .05 mfd. 400 volt.
1 .01 mfd. 400 volt.
2 .001 mfd. mica.
1 250 pf. mica.
2 100 pf. mica.

RESISTORS
1 2.0 meg. ½ watt.
2 .5 meg. ½ watt.
1 .2 meg. ½ watt.
2 .1 meg. ½ watt.
1 5,000 ohm 1 watt.
1 300 ohm ½ watt.
1 175 ohm 3 watt ww.

SUNDRIES

Hook-up wire, tinned-copper wire, 3 3-lug tag strips, spaghetti, power flex, power plug, miniature speaker plug and socket. 3 7/16" rubber grommets, 1/8" washers, 4 knobs, &c.

two of the best . . .



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RC500 "COLLARO" the world's best record-changer

Check these outstanding COLLARO advantages against any other record-changer.

1. With only three moving parts the COLLARO always remains in adjustment and cannot jam.
2. Plays nine records, either 10" or 12" as selected.
3. Amazingly quick and easy . . . to load . . . to play singles . . . to reject . . . to unload . . . to stop,
4. Crystal or high fidelity moving pick-up
5. Incredibly light needle pressure.
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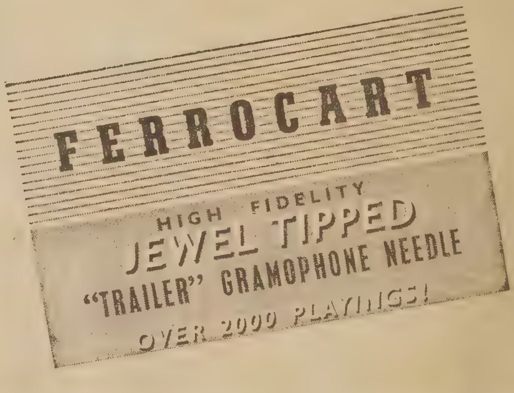
7. Triple twin-spring mounting of entire unit.

The best on record . . .



Also available in straight and midget light-weight types.

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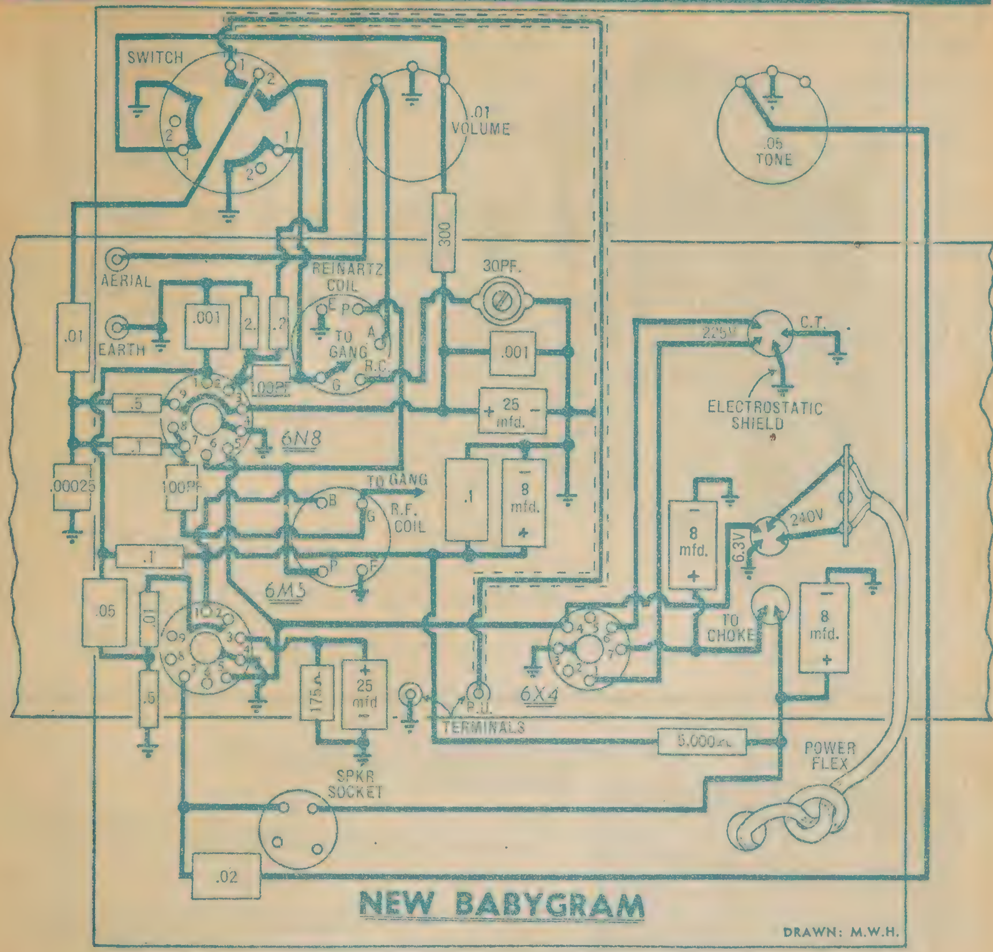
EI/2655

WIRING DIAGRAM—SIMPLE, STRAIGHTFORWARD



This diagram will greatly assist those who are new to home building. Different brands of coils may have different connections so check this point carefully. "F" and "E" connections of reinartz coil are generally common.

passed to earth, but the value of the bypass condenser is carefully chosen so that it has little effect on audio frequencies. The signal from the screen is coupled to the power pentode by means of the .05 mfd. condenser.

Since a diode detector is available it would be possible to apply automatic volume control to the pentode R.F. amplifier, but this scheme has one serious disadvantage which made us decide to adopt the simpler manual form of control.

Under conditions of very strong signals, the triode section will behave as a detector and pass signals on to the output valve completely bypassing the diode detector. Since the signals heard in the output by this means are only selected by one circuit, the effect is that a number of stations are heard together weakly in the background.

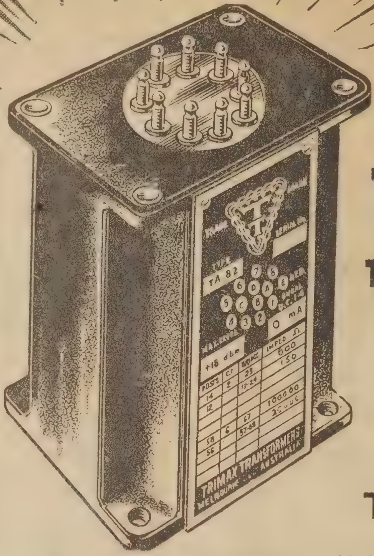
The problem is much the same as is encountered with reflexed amplifiers in superhets and the most satisfactory solution is to use a manual gain control. The potentiometer can then be wired to short the aerial in the extreme anti-clockwise position and provide sufficient control for extremely strong signals.

All we have just said applies equally to the original Christmas Box circuit and the new radiogram. However, in the radiogram, it is necessary to be able to connect the output of the pickup to the audio amplifier section of the set. This could be achieved by a simple switch which changes the audio lead from the detector circuit to the pickup terminals, but there is a possibility of strong radio signals being detected, and also the manual R.F. gain control has some effect on the audio channel since it controls the bias on the triode section.

In order to overcome these troubles, the final design incorporates a 3-pole 3 position switch which in addition to switching the audio lead, shorts out the first tuned circuit and renders the manual gain control inoperative in the pickup position.

The volume control for the pickup channel is most conveniently mounted on the motor board near the pickup so that, having switched from radio to pickup, there is no need to readjust the radio controls. If you wish you can mount the turntable, pickup and volume control in a small case, suitable for mounting alongside an easy chair and connect it to the set by means of a length of low capacity shielded cable.

Practically any type of pickup except a lightweight magnetic is suitable for use within the set. The amplifier section, operated at full gain requires an input of only .3 volts to



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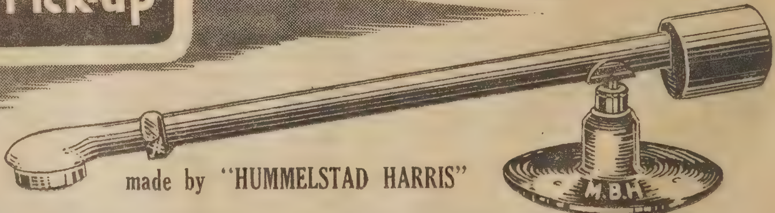
Needle Pressure 6½ grammes (¼oz.)

Plug-in Sapphire Styli for standard or microgroove records

Highest vertical and lateral compliance



made by "HUMMELSTAD HARRIS"

The incomparable performance of the "M.B.H." is recognised by such high fidelity authorities as broadcast stations, record manufacturers and Government departments.
Response: Flat from 50-20,000 cps. within the guaranteed limits of plus 0-3db from 50 to 18,000 cps. and not more than minus 5db at 20,000 cps.

Intermodulation distortion and harmonic distortion less than any other pickup on the market.
Needle pressure 6½ grammes (¼ ounce).

12" model	£8/18/-
16" model	£12/10/-
TRANSFORMER 600-GRID	£2/17/6

UNITED RADIO DISTRIBUTORS Pty. Ltd.
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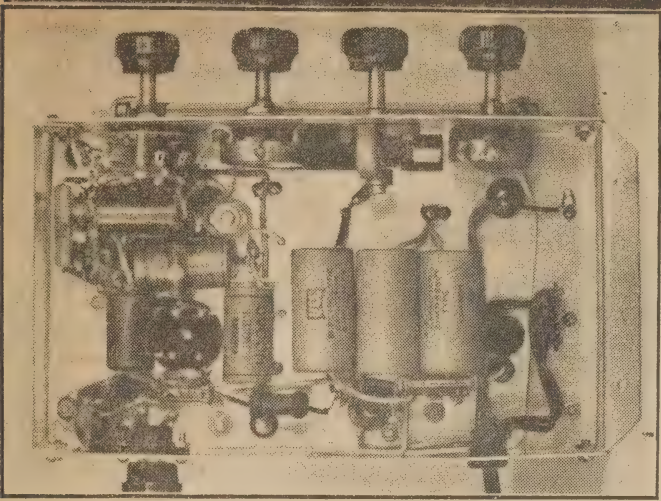
UNDERNEATH BABYGRAM CHASSIS



The chassis is large for easy wiring without undue crowding.

deliver full output. Conventional magnetic pickups as fitted to radiogram units and automatic record changers are capable of providing plenty of output.

If you are lightweight pickup conscious (a very good way to be, especially with the new sales tax on records!) there is plenty of gain for a lightweight crystal.

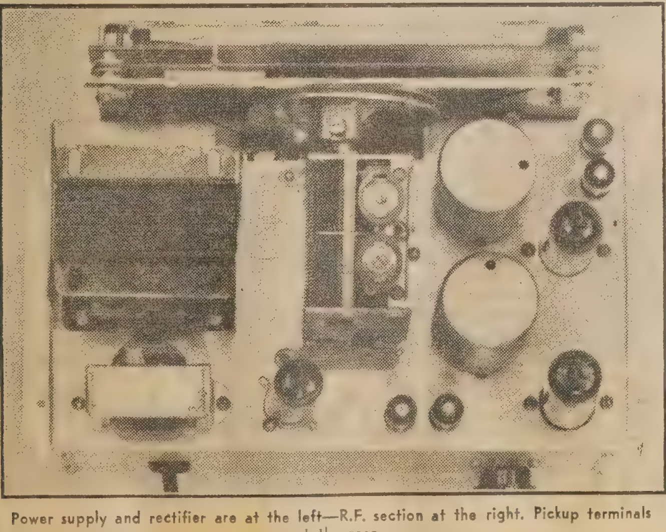
Take care to operate the pickup into the correct load resistance in the interests of best quality. It is a good idea to check this point with the manufacturer's data, but most magnetic pickups work best with a load of about 50,000 ohms, while .5 meg and above is usual for crystal pickups.

The assembly work and wiring is well within the reach of the average handyman, and you should be able to complete the job within a few evenings. Don't set yourself any special time, but take as long as is necessary to make a neat job with all components firmly mounted in place.

WIRING

It is quite impossible in an article, such as this to point out all the pitfalls and all the tricks of wiring so that if you have never built a set before, the best we can advise you is to examine another radio and note how the job is done.

Begin by mounting all the major components, including power transformer, choke, tuning gang, coils,



Power supply and rectifier are at the left—R.F. section at the right. Pickup terminals are at the rear.

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Handy Plaid Dispenser with
300 ins. ½-in. TAPE . 2/6
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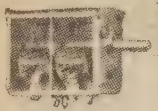
Cast bowls, book-ends, lampstands, statuettes, gifts, novelties, etc. Learn new, easy Moulding Arts. Start Home Business. Send stamp for details of this and other Money Crafts. Dept. B, Le Bon College (regd.), Box 279, Haymarket P.O., Sydney.

BARGAINS GALORE

Our January specials are always good buying—this year they are better than ever, all brand new (except where otherwise specified) and fully guaranteed—some ex-disposals others surplus stocks—mail your order now as many lines will be quickly sold out.

POLAR TWO GANGS



A popular miniature two-gang. Capacity 385 mmF. Size 1¾" x 1½" x 2". With ¼" shaft. Worth 22/6.

15/-

LOW CAPACITY SWITCHES

Lever action anti-capacity switches. (Similar to key switch) made by Muirhead. D.P.D.T. Ideal for special test instruments, each. **3/6**

4-pole D.T. Key Switches, 5/6.

VALVES

The following valves are slightly used but guaranteed as new.

6H6 Diodes.
7193 HF Triodes.
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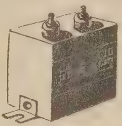
CONDENSERS



1 mF 2000 V.W. Moorehead in bakelite case	**5/-**
0.002 mF 900 V.RMS working in bakelite case	**1/-**
0.25 mF 2000 V.W. metal case	**1/6**
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WESTECTORS

Copper Oxide Rectifiers, type WX6. Mounted in glass tube with bakelite ends. Fitted with screw terminals. Ideal for wavemeters, diode rectifiers, &c. These are usually sold at 8/6.

3/6

Dr. Cecil's Radio Crystal for crystal sets.

9d

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The following are high-grade English meters. As stocks of each type are limited, order now.

0-1 mA 2" with square face	**32/6**
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0-12 volts, 3" round. Projection type case. Scale 0-12-120..	**30/-**
0-500 micro-amps. Ferranti, 2" diameter.	**37/6**

THROAT MICROPHONES

English type, consisting of two microphone units completely sealed against moisture; neck strap; cord and plug. Limited stocks only.

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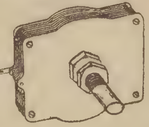
WAVEMASTER CONDENSER



English solid dielectric condensers for crystal and simple valve sets. Very compact. Size 2" x 1¾" x ¼" with ¼" shaft. Capacity 0.0005 mF.

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BARGAIN PACKET OF RESISTORS

Half pound of assorted resistors, all useful sizes. Some not coded but can be selected with ohmmeter. The coded ones alone are worth more than 10/-:

2/6
(Post Free)

I.F. TRANSFORMERS

Again we offer Kingsley I.F. transformers. Standard size can; Permatune; for 455 kc/s. Buy all you require now, as there will be no more after present stocks are sold.

2/-

VIBRATORS

Oak type 35UH. 6-volt synchronous; split reed. Can be used in place of standard 6-pin type by changing socket.

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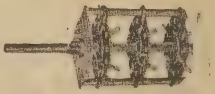
SWITCHES



Oak type. 3-pole; 3-position 3-bank. Close spacing	**7/6**
Oak type. 2-pole; 4-position; 2-bank. One ceramic section. Wide spacing	**7/6**
Oak type. 2-pole; 4-position; Single bank	**6/6**
Miniature single pole; 4-position; 1¼" dia.	**2/-**

1 meg Potentiometers with S.P. Switch	**4/9**
Pye type Co-axial connectors, plug and socket	**2/6**
Phone Cords. English 6' long	**3/3**
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Eddystone Broadcast RF Chokes	**2/-**
Dynamic Phone Units. 45 ohms	**5/-**
Headphones. Low Resistance ex-Disposals	**7/6**
Ceramic Formers. 2" dia. 4" long. Threaded 16 TPI	**1/-**
Ceramic Formers. 2" dia. 6" long. Threaded 3 TPI	**1/-**

PLEASE ADD SUFFICIENT FOR POSTAGE — ANY SURPLUS WILL BE REFUNDED

PRICE'S RADIO

5-6 ANGEL PLACE, SYDNEY

terminals and valve sockets. Before actually bolting the gang in place, solder a few inches of hookup wire to the terminals for both sets of stator plates and pass them through the holes in the chassis.

Do not forget the rubber grommets for the power transformer leads, and also the choke leads, as there is always a possibility of the sharp edge of the steel chassis cutting through the insulation and causing a short circuit.

This point is particularly important with regard to the mains lead, which passes through the rear of the chassis. It is well worthwhile to install a tag strip to anchor the junctions of the power cord and the leads from the transformer. Tie a knot in the power cord inside the chassis to prevent accidental strain being concentrated on the tag strip.

Before installing the function switch and the remaining controls along the front of the chassis, it is a good idea to solder a length of hookup wire to the aerial terminal, the aerial connection of the reinartz coil, and also the plate and earth connections which are partly inaccessible when the switch is in place.

With all the controls mounted, complete as much of the wiring as possible before installing any of the resistors and condensers. This will help to keep the connecting wires close to the chassis and help avoid a spider web appearance. Also, keep all the resistors and condensers as close to the chassis as possible and cut the leads reasonably short so that there is no tendency for the components to flop around when the set is moved. Spaghetti, or insulating tubing, is very valuable for covering the ends of components since it obviates the possibility of a short-circuit should the leads from neighboring components happen to touch.

Where there is a junction of several components always make it at a valve socket, switch contact or coil terminal where possible. If there is a junction of several components which does not occur at such a point, instal a tag strip or insulating pillar with a solder slug screwed to the top. There are several such instances in this set.

The only shielded wire in the set is that running from the pickup terminal to the switch. However, there are several resistors and condensers in the audio input section which are likely to pick up electrostatic hum, and which it is impossible to shield in the normal way. With the set in operation, there is a slight high pitched hum. It is by no means intolerable, but we thought it well worth while to fit a shield under the chassis. With the shield in place the hum trouble was completely eliminated.

SHIELDING

The shield can be made from a piece of scrap steel, aluminium or even tinplate. Its exact dimensions are not particularly critical, but the shield used in the original is 3" wide, and extends right across the chassis covering all the wiring around the valves.

SPECIFIED FOR THE NEW BABY GRAM

PHILIPS
INNOVAL

TYPES
6N8 & 6M5

Innoval is the new basic valve construction suitable for all electronic applications including AM, FM and Television. Innoval incorporates revolutionary advances in production methods and has the internationally standardised 9 pin Noval base. This construction provides the means by which even the most complex receiving valve types can be made in a miniaturised form—with more ruggedness, greater efficiency and uniformity than ever before.

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Throughout the world this symbol guides the choice of millions.

The duo diode RF/AF Pentode type 6N8 and the High Sensitivity Output Pentode type 6M5 used in the Radio and Hobbies New Baby Gram are but two of the Innoval types now available. Full details of the complete Innoval range may be obtained from your nearest Philips Branch.

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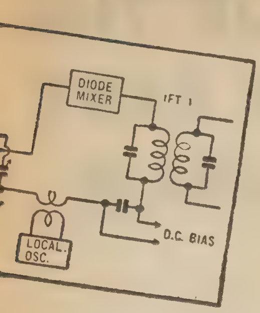
Radio Components



For the radio amateur, technician, radio engineer and all Government projects, John Martin are proud to announce:—

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Fuses, fuse holders, plugs, sockets, terminals, mains filters, aerials, all readily available.

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All resistors approved by British Blue Book 1001—used in all U.S.A. and British Service Equipment—now used by all discerning amateurs, technicians and engineers, etc.

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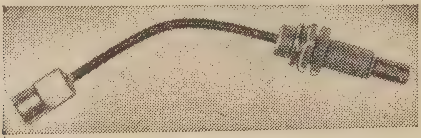
The wide range of condensers, dials, insulators, etc., are all on display and we invite your inspection.



Bulgin

Switches, begels, plugs, sockets, knobs, fuses, micro-switches; flashers etc.

All the components are readily available ex stock.—You are invited to inspect our large range of first quality BRITISH Components.

JOHN MARTIN PTY. LTD.

116-118 CLARENCE STREET.

Phone: BX5061 (5 lines). Telegrams: "Jonmar."

Carefully recheck the wiring before connecting the set to the mains. Even experts have been known to make wiring mistakes!

For a start, plug in the 6N8 and the 6M5 and switch on the power. The heaters will reach a dull red temperature in about 30 seconds if everything is in order.

Switch the power off, plug in the 6X4, and switch on again carefully watching the heater, which should heat to a dull red in about 30 seconds. There should be no sign of color on the plates.

Continuous blue flashing between the heater and plates or a blue glow filling the entire envelope, indicates that there is either a short in the high tension or the valve contains an abnormal amount of gas.

BLUE GLOW

The blue glow throughout the envelope should not be confused with the small fluorescent patches which sometimes appear on the envelope, as the latter is usually an indication that the valve has a good vacuum.

The chances are that you will not strike any of these troubles, but we mention them in case you happen to be unlucky.

If everything is in order, there will be a loud hum or squeal from the speaker when the "live" pick-up terminal is touched. Adjust both trimmers on top of the tuning-gang to about half capacity and connect an aerial. It should be possible to tune in a signal in any of the suburbs given a few yards of aerial.

Space does not permit us to give the alignment procedure in detail again, but the full details given for the "Christmas Box" on page 61 of the December issue also apply for the radiogram version.

Finally, for those of our country readers who are interested in the set it would be quite permissible to modify the design to include an adjustable regeneration control, so that the reaction can be always adjusted to the optimum position. This is quite easy with the new chassis.

A miniature variable condenser can be installed in the present position of the volume control, and the volume control shifted to the hole now occupied by the tone control. No tone control will then be available, and you may find the tone more pelasant with a .05 mfd or a .01 mfd condenser connected across the speaker plug.

PLASTIC insulating tubing melts at rather low temperatures, and presents some difficulty when soldering. This is particularly so where a sharp bend exists near the point to be soldered. One way of attacking this problem is to hold the tubing in place with a small pad soaked in methylated spirit. The pad may be of cloth, cotton wool, or a small piece of felt. Because the spirit evaporates quickly, it cools the joint and the adjacent wire, making it easy to hold the tubing in place. Moreover, it does not have any adverse effect on the insulation, and any surplus spirit dries in a few seconds.

FROM THE SERVICEMAN WHO TELLS

Here is the last of four special articles on bookkeeping for the serviceman. We trust you have found them helpful. Next month we will be back on to technical subjects with another series of anecdotes from "The Serviceman Who Tells."

When I left you last month you had just completed the postings into the Ledger of your credit transactions from your Purchases and Sales Books.

The next step is to compile a Trial Balance as you did at the end of Lesson two. This proves the arithmetical accuracy of your bookkeeping and forms the basis for the preparation of your Profit and Loss Account.

If your books have been correctly kept the total of both the Debit and Credit sides will be £570. The balances of the accounts will appear as in Figure 1.

Not all these accounts go to make up the Profit and Loss Account; some of them go into the Statement of Worth or Balance Sheet. It is necessary therefore that you should understand how to classify your accounts.

THREE GROUPS

There are three primary groups:—

1. Real Accounts.
2. Personal Accounts.
3. Nominal Accounts.

Real Accounts are those which record your Assets such as Furniture and Fittings, Plant etc. Personal Accounts are naturally persons or firms with whom you have had dealings (your Sundry Debtors and Creditors) while Nominal Accounts are all your expense accounts (e.g. Rent, Advertising, Telephone, etc.) and those accounts which record your stock transactions, i.e. Purchases, Sales, etc. your profit and Loss Account is compiled from those accounts in group 3 (Nominal) while your Balance Sheet consists of groups 1 and 2 (Real and Personal).

For your guidance I have indicated in Figure 1 whether the accounts are Balance Sheet or Profit and Loss items.

THE RELIABLE RADIO SERVICE CO.

TRIAL BALANCE

as at 31st October, 1950

	ACCOUNT	DR. £	CR. £
B/S	Capital		200
P&L	Sales		233
"	Service		32
"	Purchases	179	
B/S	Salaries (Drawings)	20	
"	Furniture & Fittings	30	
"	Plant	40	
P&L	Rent	5	
"	Advertising	10	
"	Telephone	5	
"	Power & Light	2	
B/S	L. M. Radio Co.		20
"	O. Z. Battery Co.		16
"	T. V. Speaker Co.		5
"	Valve Manufacturers		40
"	Quick Printing Ltd.		7
"	Stationery Sellers Ltd		6
"	Y. Radio Co.		11
P&L	Stationery	6	
"	Freight	3	
B/S	J. Jones	39	
"	S. Smith	28	
"	T. Harries	37	
"	J. Kent	28	
"	K. Barry	33	
"	Bank	105	
		£570	£570

Fig. 1

PROFIT AND LOSS ACCOUNT

for the month of October, 1950

DR.	£	CR.	£
To Purchases	179	By Sales	233
" Gross Profit c/d	126	" Service	32
		" Stock on hand 31/10/'50	40
	£305		£305
To Rent	5	By Gross Profit f/d	126
" Advertising	10		
" Telephone	5		
" Power and Light	2		
" Stationery	6		
" Freight	3		
" Net Profit Transferred to Capital a/c	95		
	£126		£126

Fig. 2

We now turn to Figure 2, the Profit and Loss Account, and notice that it is in two sections. The first section shows you your Gross Profit for the month: the second section your Net Profit.

The first section is really your Trading Account and is usually headed accordingly, but for simplicity I have retained the general heading of Profit and Loss Account.

This trading section shows you what has been happening throughout the month to the stock you have bought for re-sale. Have you made a profit or a loss on the sale of this stock? You are vitally interested in the result for upon it depends the success or otherwise of your enterprise.

TOP SECTION

Looking at the compilation of the top section of the Profit and Loss Account we see that the first item on the Debit side is Purchases. This figure of £179 represents the total amount of stock purchases by you during the month for resale.

On the credit side we have the selling price of that part of your Purchases which has been resold, plus the amount received by you for service work and finally the value of stock on your shelves still unsold as at 31st October, 1950. This last figure is arrived at either by—

(a) Going around and counting everything and valuing it.
(b) Keeping a stock card showing the quantity and value of each item of stock.

Even if you do have a system of stock cards in operation it is necessary to have a "physical" stocktaking at least once a year and periodically to check the cards with the actual stock throughout the year. Should your physical check reveal no movement over the past year on any particular items the card should be marked as "slow moving" and an effort made to dispose of same at the earliest opportunity.

TOTAL CREDITS

Having inserted the figure of £40 representing stock on hand as at 31st October, 1950, this brings the total credits to Profit and Loss Account to £305. The total cost of goods purchased was £179 therefore your Gross Profit is £126 which amount is carried down to the credit side of the second section of the Profit and Loss Account.

Before we pass on to this second section I wish to point out here that your closing stock figure (£40 at 31/10/50) will become the opening stock figure for next month. When you do the Trading Portion of your

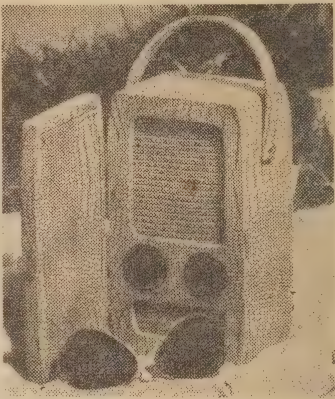
Holiday Time
IS PORTABLE TIME

BUILD IT YOURSELF!

It's quite simple, provided you build to a tested and tried circuit and use only the very best components. Electronic Parts kits are compiled to specifications laid down by "Radio & Hobbies" and only the very best quality components are used.

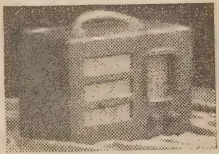
EVERYTHING necessary to build a first-class portable is included with each kit.

The holiday spirit is afoot. Make it a really happy time with a portable radio. Get the added thrill of building your own.



CARRY SET

The smartest in small portables. This 4-valver is extremely simple to construct and is most efficient in performance. Note the smart lines of cabinet, size of which is 8¼" high x 4½" wide x 4" deep. It was originally described in "R & H", October, 1949.



SENIOR PORTABLE

Originally described in "R. & H." for December, 1948, this 5-valve B/C portable, with R.F. Stage uses either 6" or 7" speaker. A kit of parts for an A.C. power supply is also available. Cabinet size of portable 12½" x 8¼" x 6½".

SPRINGTIME PORTABLE

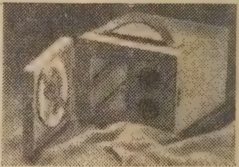
("R. & H." Oct., 1946). A sturdy 5-valve portable with R.F. Stage which will take any amount of hard work. Cabinet size, including hinged lid, 13" x 8 5-8" x 5½".

HANDIE-TALKIE

("R. & H." Oct., 1947, and Dec., 1947). The smallest possible 5-valve portable. Ideal for distance-getting, combined with compactness. A four-valve version also available in the same cabinet. Size 7" x 4½" x 5".

MULTI-TALKIE PORTABLE

("R. & H." July, Aug., 1948). As its name implies, this is a multi-unit portable. It is available as a small 4-valve B/C portable and, in addition, an A.C. power unit can be built to enable it to operate from the A.C. mains, or a vibrator unit can be built to enable it to operate from a wet battery. Size of portable cabinet 7" x 4½" x 5¼".



Send coupon for free list of these portable kits, which includes over 50 different varieties of radio kits, battery sets, A.C. sets, car set, gramo-comb, vibrator sets, 32-volt set, etc., etc.

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Please send me without obligation on my part, price list of your portable kits. (Enclose stamp to cover postage).

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KIT SET SPECIALISTS

Profit and Loss Account for the month of November your first entry will be Stock 1/11/50 £40. Then will follow your Purchases for November and you will proceed with the remainder of the account in the same way as October.

One further point to remember is that this stock figure (£40) must also be shown on the Assets side of your Balance Sheet. That is because it is owned by you at 31st October (Refer Figure 3).

Having arrived at our Gross Profit we now debit Profit and Loss Account with the expenses which have been incurred in making the Sales and doing the Service Work set out in the top section. The result is your final Net Profit for the month of October. Turn again to your Trial Balance and you will see that all these accounts are marked Profit and Loss. You will recall that these belong to the group of accounts called Nominal Accounts.

THE JOURNAL

At this stage we introduce another subsidiary book into your books of account, namely the Journal. This book has five columns — date, particulars, folio and two money columns. It is used for recording entries other than Cash Receipts and Expenditure or Credit Purchases and Sales. It is specifically known as the General Journal or Adjustment Journal for actually your Cash Book and Purchases and Sales Books are Journals, i.e. books of prime entry.

The steps outlined above necessary to compile the Profit and Loss Account represent postings from the individual accounts into one account (Profit and Loss). Such postings are known as "closing entries" because they close the accounts concerned, i.e. both sides of the accounts are made equal — there is no balance. Full details of the entries necessary to close your books at the end of October are given in Figure 4.

JOURNAL

Closing Entries

DATE	PARTICULARS		Fol.	DEBIT	CREDIT
Oct. 31	Profit and Loss A/c	Dr.	27	179	
	To Purchases				179
	Purchases for month transferred				
	Sales	Dr.	2	233	
	Service		3	32	
	To Profit and Loss A/c				265
	Being Sales and Service for month transferred				
	Stock	Dr.	26	40	
	To Profit and Loss A/c				40
	Bringing to account stock on hand as at 31/10/'50				
	Profit and Loss A/c	Dr.		31	
	To Rent		8		5
	" Advertising		9		10
	" Telephone		10		5
	" Power and Light		11		2
	" Stationery		19		6
	Freight		20		3
	Being expenses for month transferred.				
	Profit and Loss A/c	Dr.		95	
	To Capital A/c				95
	Net profit for months transferred to Capital A/c.				
	Capital A/c	Dr.	5	20	
	To Salaries (Drawings)				20
	Being drawings for month transferred to Capital A/c				

Fig. 4

In a small concern it is not always necessary to close the books at the end of each month. Provided a Trial Balance is prepared (and this is essential) a Profit and Loss Account and Balance Sheet can quite readily be compiled which will show the results of your months work and the value of your Assets and Liabilities.

Of course at the end of your financial year it is necessary to close your books in order that your accounts may be in order for the preparation of your Income Tax Return.

When you have posted all the closing entries in Figure 4 the only accounts in your ledger which will have balances on them will be Balance Sheet items. These are listed in the manner shown in Figure 3.

You will notice that the Assets are arranged in the order in which they can be converted into cash.

Bank obviously is shown first, while Plant which is an Asset of a fixed nature is shown last.

On the Liabilities side the movement of Capital is shown in detail.

As far as Sundry Debtors and Creditors are concerned these are shown as one figure only in the Balance Sheet. The individual persons and firms are listed separately underneath.

BALANCE SHEET

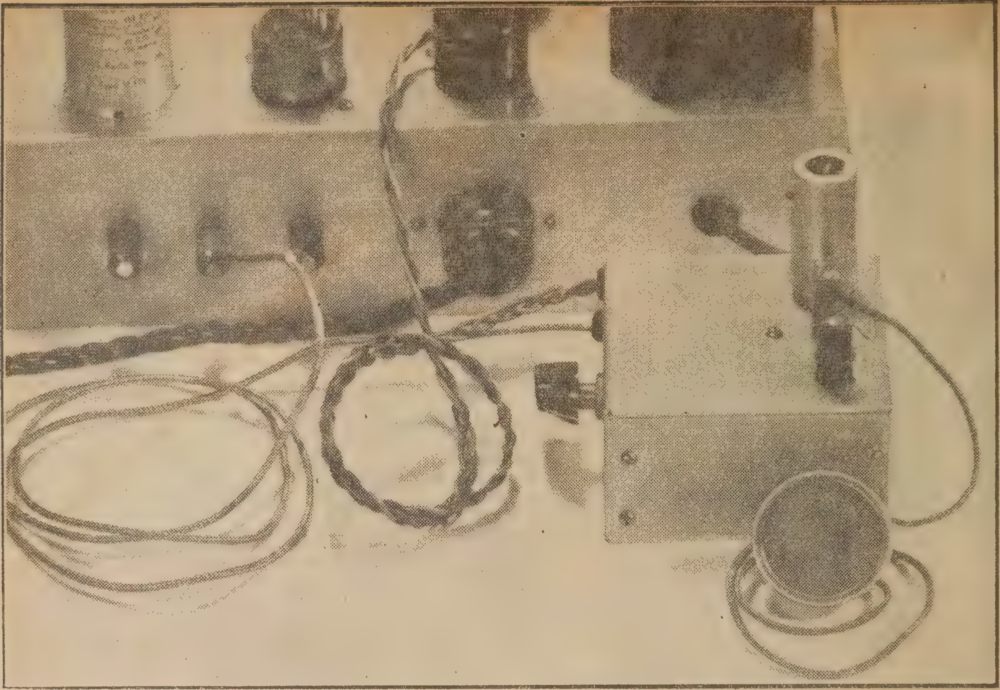
as at 31st October, 1950

LIABILITIES	£	£	ASSETS	£
Capital 1/10/'50	200		Bank	105
Add Net Profit			Sundry Debtors	165
for month	95		(See below)	
	295		Stock	40
Less Salary drawing	20	275	Furniture and Fittings	30
Sundry Creditors		105	Plant	40
(See below)				
		£380		£380
SUNDRY CREDITORS			SUNDRY DEBTORS	
L. M. Radio Co.		20	J. Jones	39
O. Z. Battery Co.		16	S. Smith	28
T. V. Speaker Co.		5	T. Harris	37
Valve Manufacturers		40	J. Kent	28
Quick Printing Ltd.		7	K. Barry	33
Stationery Sellers Ltd.		6		
Y. Radio Co.		11		
		£105		£165

Fig. 3

MOUNTING COIL CANS

WHEN mounting coil cans on a chassis, take it easy with the pressure applied to the mounting nuts. The threaded lugs are only riveted to the can, which is of soft aluminium. If you are using a spanner, it is all too easy to pull the rivet right out of the can. The damage to the can is usually of such a nature that repairs are almost impossible, remembering that aluminium cannot be soldered, and so the coil is rendered useless until a new can is obtained. So, when using a spanner on these nuts, keep your eye on the rivets for the slightest sign of strain.



Here is the pre-amplifier unit with crystal microphone insert connected. Power is taken from a special adaptor for the output valve socket. The unit connects to the pickup terminals of the receiver.

A MICROPHONE PRE-AMPLIFIER

This article describes the construction of a preamplifier which may be connected to a standard radio receiver for microphone use. It will be particularly useful to those planning to use their receivers for direct home recording. Cost is small and fitment simple.

by Philip Watson

THE not-so-advanced enthusiast often has a need for a small PA system, such as might be suitable for a party or small public meeting. Feeling that the cost of a separate amplifying system may not be justified, his thoughts turn to the domestic receiver and to the possibility of using it as it stands, or with small modifications or additions.

A question which frequently appears in our mail is, "Can I use a microphone through the pick-up terminals of my radio?" The answer to this is usually "No," because the ordinary receiver has not enough sensitivity to amplify the weak microphone signals to the point of useful output.

CARBON MIKES

An exception to this is the carbon type, similar to those used in telephones, and which has a very high output.

However, these are not very suitable for PA work, having a restricted and rather peaky frequency response, a high noise level, and a not always consistent performance.

Something better than this is required for a really satisfactory job, and the two most popular types are the crystal and the dynamic or moving coil.

Although the output varies with make and model, it may generally be said that the crystal has the higher output of the two. Add to this the low cost of crystal inserts now available, and this type begins to look very attractive. The housing of the insert in a suitable case is all that is required to complete the microphone, a task well within the scope of most enthusiasts.

It now remains to provide a pre-amplifier ahead of the receiver pick-up terminals, and it is the purpose of this article to describe such a unit.

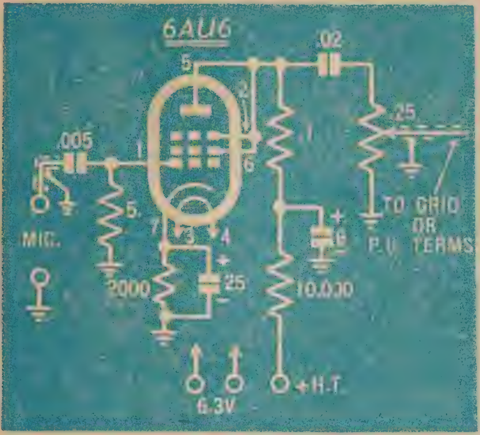
Power for the device may be taken from the receiver, since the HT drain will only be in the order of a milliamp or two at the most, while the extra 300 mills of filament current is not likely to exceed the power transformer ratings.

It is this scheme which really makes the idea practical, since the cost of a separate power supply would exceed that of the amplifier section. As it is, the entire unit consists of a single valve and a half-dozen minor components, all mounted on a small chassis, and capable of being quickly plugged into the main receiver.

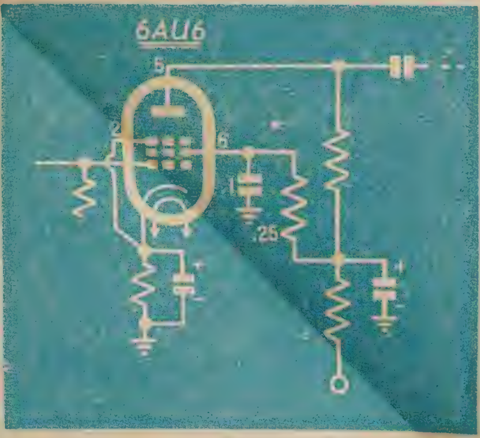
TRIODE CONNECTION

Reference to the circuit (Fig. 1) will show that a 6AU6 miniature

TWO CIRCUITS FOR THE MICROPHONE PRE-AMP.



Left—The valve is here shown connected as a triode.



Right—Here are the pentode connections for higher gain.

type valve is used in a simple triode arrangement, which gives more than sufficient gain for a crystal microphone when used with the average radio receiver.

The original unit was tested in conjunction with the No. 1 Kit receiver described a few issues back, and with several different types of microphones.

The first was an Acos Mic. 19 insert, for which plenty of gain was available. Next, a "Dynamike" moving coil was tried and, although the output was noticeably less, quite satisfactory results were obtained under close talking conditions. With the circuit modified, as shown in Fig. 2 (pentode connection), plenty of gain was available to allow the Dynamike to be used under all conditions.

The final test was with a high-quality ribbon microphone, having the rather low output which is characteristic of this type. The result here was somewhat better than expected, providing quite useful output under close talking conditions, with the valve connected as a pentode.

Thus, in one form or another, the unit may be regarded as having enough gain for use with all but the lowest output types which, in any case, are usually only associated with the most advanced type of gear.

SAFETY CONDENSER

Although the circuit is quite a simple affair, a few points may bear discussion. The .005 condenser in the microphone input circuit is mainly a safety measure when using a crystal. These units may be damaged if a voltage is applied to them, and this may happen if the valve, for any reason, should draw grid current. With the isolating condenser in circuit your crystal is quite safe.

The 5 megohm grid resistor is the usual value for use with a crystal, but, if it should prove higher than recommended for other types of microphone, a lower value, say, 0.1 megohm, may be shunted across the input terminals or wired permanently in place of the 5 meg.

The 10,000 ohm resistor and the 8 mfd electrolytic condenser form a decoupling network, providing additional filtering of the H.T. ripple, which would normally be too high to use with this degree of amplification.

The gain control in the output circuit will really only be needed if the receiver volume control does not operate in the pick-up circuit.

In the event of no pick-up terminals being fitted, it may be necessary to make connection direct to the grid of the audio valve.

For the triode connection, the suppressor and screen are connected to plate while, for the pentode connection, the suppressor goes to the cathode and the screen to its own supply resistor. This is a .25 megohm, the screen end of which is by-passed with a 0.1 mfd condenser. These two components are the only additional items needed to make the change. We suggest that you wire the valve first as a triode and see whether the gain is adequate. If not, then change to the pentode connection.

POWER SUPPLY

Power for the unit is taken from the receiver by means of an adaptor which plugs into the output valve socket, while the output valve plugs into the adaptor. Three leads connect to the pre-amplifier, two carrying the filament supply, and the third providing the H.T. connection.

The negative return lead is provided by the shield braiding on the lead to the pick-up terminals, and care should be taken to see that this connection between the chassis is made before the adaptor is plugged into the valve socket. If this is not done the two chassis will have a high voltage between them, and can deliver a nasty shock.

The original adaptor was made from a standard Amphenol socket, and the base from a discarded valve. The octal size was used in our case, but, of course, you will select a type to suit the output valve in your particular set.

ADAPTOR

If possible choose a valve base which will allow the socket to fit neatly inside it, and remove all traces of glass, &c., from the inside. Heat

PARTS LIST

1 aluminium chassis 3½" x 3½" x 2"
1 6AU6 valve
1 Miniature 7 pin socket and shield combined
1 25 mf. 40 volt electrolytic condenser
1 8 mf. 500 volt electrolytic condenser
1 .02 mf. 400 volt paper condenser
1 .005 mica condenser
1 5.0 megohm ½ watt resistor
1 .25 megohm potentiometer
1 0.1 megohm ½ watt resistor
1 10,000 ohm ½ watt resistor
1 2000 ohm ½ watt resistor
1 valve socket and valve base to suit receiver
2 terminals
1 knob
Shielded hook-up wire
Nuts and bolts, solder lugs, tag strips, etc. Additional for pentode connection
1 .25 megohm ½ watt resistor
1 .1 mf. 200 volt condenser

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★ R.12.D
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This is the same unit as incorporated in the R.33 and is intended for installation and connection to your own radio or sound projector amplifier.

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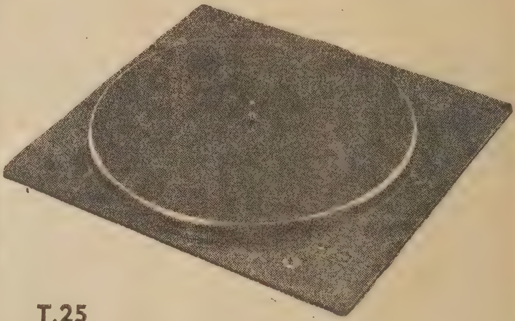
Byer Industries have now installed precision sapphire stylus sharpening equipment. You will save pounds by taking advantage of this quick expert service.



T.25
SUPER SILENT TURNTABLE

A professional type turntable for amateur use, available with or without pickup. The T.25 will rotate at constant speed. As a result, "wow", "flutter" and "rumble" so often found in ordinary turntables has been completely eliminated. Wide margin of reserve power and inertia of the cast turntable overcome the common tendency to slow down on the heavier passages and more violent transients. The motor, mounted on floating buffers, is synchronous and gives constant correct speed, at either 78 or 33 1-3 r.p.m.

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Wellington.

the end of the pins with a soldering iron, and with a flick of the wrist remove the solder from the inside of each one.

Select a gauge of tinned copper wire which will suit the bore of the base pins, and solder a piece about three inches long to the bottom of each of the socket pins. Three pieces of hook-up wire will also be required, and one should be of a distinctive color. Connect this one to the screen pin of the socket, and the other two to the filament pins.

A hole must now be drilled in the side of the valve base, large enough to take the three wires. This must be done carefully as there is a danger of breaking the bakelite material. It is best to start by drilling a small hole and use slightly larger drills successively until the required size is reached.

Feed the three lengths of hook-up wire through this hole, and then insert the tinned copper wires into the appropriate pins in the valve base. Make a final check with an ohm meter or similar device, to see that the base pins are connected to the correct socket pins. If so, solder the wires to the pins, allowing a little of the solder to run inside the pins. Avoid large blobs on the outside. Clip off the surplus wire and the adaptor is complete. The three wires may be plaited if you wish, after which the unit is ready to wire into the amplifier.

CHASSIS

The chassis measures 3½in x 3½in x 2in deep, and the original was made from a small sheet of aluminium. No doubt by careful selection of components they could all be accommodated on a smaller chassis, but it is likely that in most cases use will be made of components already on hand. This size allows it to be done without undue crowding. On the other hand there is not much point in packing everything into an ultra midget chassis, merely for the sake of doing so.

Although the 6AU6 valve is specified there is no reason why one of several other types may not be used. Suitable ones would be the 6SJ7, 6J7, or the 6C6, with the correct shield and socket substituted in each case. With some modification in layout it should still be possible to use the chassis size given above. The gain of the 6AU6 is higher than the alternative types, but one of the two arrangements shown should give enough gain for most cases, as the difference is not very great.

Of course, if you have an oddment triode on hand, it could be used quite well by selecting the correct socket and making sure that it operates with the same heater voltage as the output valve in your set. In most cases, the value we have suggested for the plate and cathode resistors will be quite in order.

CONSTRUCTION

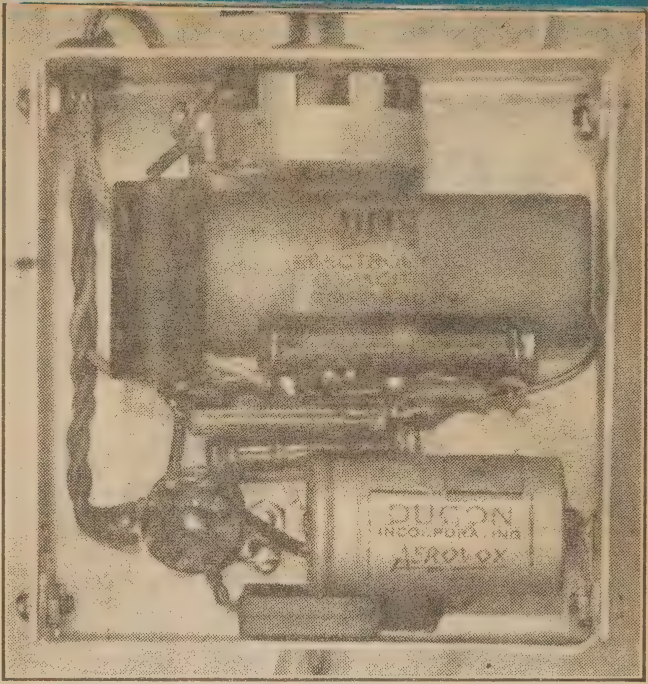
The wiring and mounting of the few components is not a difficult task, and the use of one or two tag strips will provide convenient anchor points. In our case we used a single strip having seven lugs, and the exact manner in which it was used may be seen from the under-chassis diagram. Don't forget to earth the centre spigot on the miniature socket, as this provides a shield between valve pins.

If the receiver has a volume control which operates in the pick-up circuit, the one in the amplifier may be dispensed with. Simply connect direct from the .02 mf. condenser to the pick-up terminal.

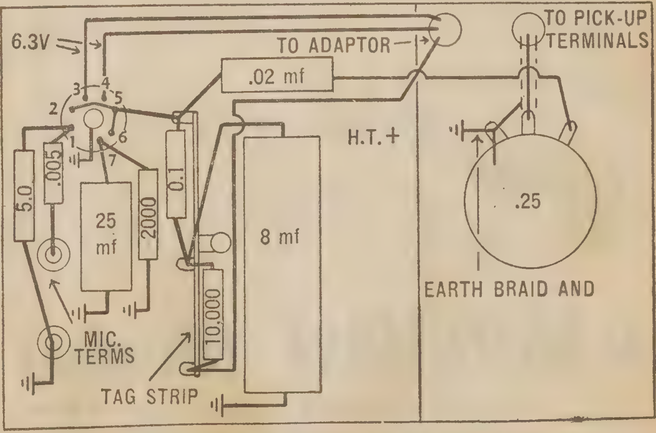
On the other hand the receiver may not have any pick-up terminals, and it will be necessary to connect direct to the grid of the audio tube. In this case the shielded cable should be terminated with a suitable grid clip on the inner conductor, and a short lead to connect the outer shield to the earth terminal.

(Continued on Page 89.)

UNDERNEATH VIEW OF PRE-AMP.



An underchassis photograph of the unit.



A wiring diagram to be compared with the above photograph.

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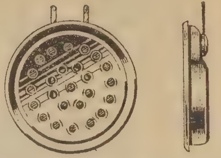
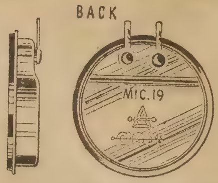
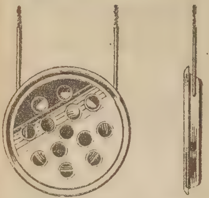


MIC. 3 DIAPHRAGM-ACTUATED crystal microphone, specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity.
Price: £1/8/2.



MIC. 19 SINTERCEL fulfils the requirement for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction.
Price: £2/15/0.



MIC. 18 MICROPHONE SPEECH INSERT provides high acoustic qualities with minimum bulk. Where exceptional slimness is required, this Insert is recommended.
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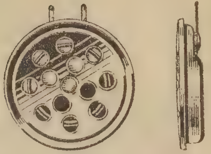
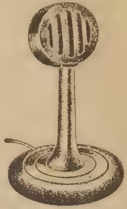


MIC. 14 STANDARD SPEECH MICROPHONE INSERT with nickel-plate brass case which gives high corrosion resistance, mechanical strength and rigidity.
Price: £1/8/2.



TYPE "A" MICROPHONE. Specially designed for clear production of speech. Ideal for public address; office and factory call systems; amateur and mobile radio transmitters, etc.
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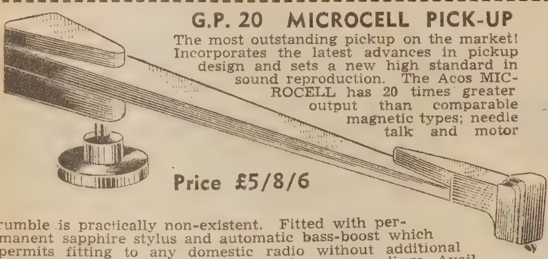

G.P. 20 MICROCELL PICK-UP

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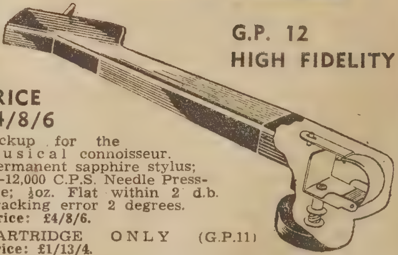
Price £5/8/6

CARTRIDGE ONLY (G.P.19) .. .. Price: £3/1/6

ACOS
CRYSTAL PICK-UPS



G.P. 12 HIGH FIDELITY

PRICE £4/8/6

Pickup for the musical connoisseur. Permanent sapphire stylus; 25-12,000 C.P.S. Needle Pressure; ½oz. Flat within 2 d.b. Tracking error 2 degrees.
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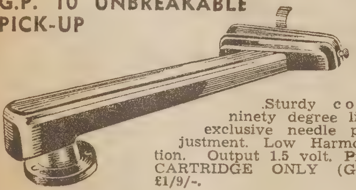

G.P. 10 UNBREAKABLE PICK-UP

PRICE £2/13/6

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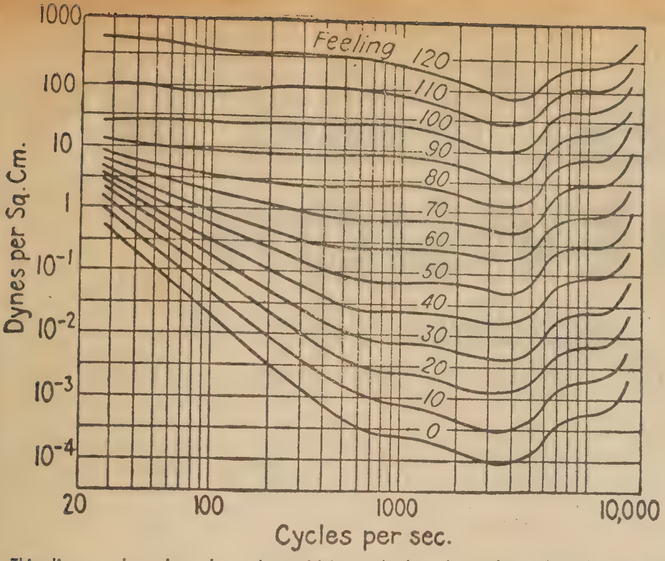

This diagram shows how the ear's sensitivity at both ends of the scale falls off as volume decreases. Each curve represents a volume change of 10 db.

Let's Buy An Argument

The business of arguing in print has its complications. To have the desired effect, the statements must be provocative, they must not contradict what has already been said and, last but not least, they must be accurate. Herein lies the trouble. Having fulfilled the last two conditions, you find the Editor sneering in a nice kind of way and suggesting that no one will want to disagree with any of that.

by W. N. Williams

WHEREUPON he proceeds to ridicule my criticism of disc recordings and debate the subject for a solid half hour. Not contentious? Not half!

That little note on page 67 of the last issue was a tacit invitation on the part of the Editor to shoot me and my arguments full of holes. And as for secretly agreeing, &c . . . "I'd rather die than say yes . . . ."

Then there's another difficulty. You pour out words of wisdom on a certain subject and, best part of a month later, it appears in print.

TIME DELAY

Someone reads it in the train but can't answer it immediately because of lodge, church or Aunt Martha's funeral. So he spends the following week cooking up a vitriolic letter, by which time another issue has gone to the printer. Perhaps that's why I'm still being hauled over the coals about references to theory and practice.

For example, there's one letter here from Mr. Newbold, a South Australian reader. Written in a charmingly disarming way, it brings one up with a jolt — rather like a court summons! A couple of the points I've already covered, in all innocence, but Mr. Newbold's letter warrants an answer. Summarised, it goes like this:

(1) The 2A3 in my amplifier doesn't draw the rated plate current. Do the theoretical values still apply or must I draw a new set of curves for my 2A3 to work it under your theoretically proper conditions?

We can get out of that one all right, Mr. Newbold, because we've already explained that valves are likely to vary from the published characteristics by 10 or 20 per cent, according to the maker's tolerance. The general idea is to operate any individual valve under standard voltage conditions and accept the possibility of the power output and distortion figures being somewhat higher or lower than the published values.

There's nothing to stop you taking your own curves, apart from the difficulty of doing so and the likelihood of ruining the valve in the process. So much for the first point.

(2) I have been dazed to learn that circular number 74 (1924) of the US Bureau of Standards provides inductance formulas and tables capable of one part in one thousand accuracy over a very wide range of coil sizes and shapes. Would an inaccuracy of one part in one thousand in these "theoretical" data be enough to make the theory untrue?

A CURLY ONE

Now, that's what you'd call a curly one, but it all depends what the theory says. If, theoretically, the inductance of a coil varied *approximately* as the square of the turns, then you would be hard put to it to disprove the theory on figures. But omit the word "approximately" and you either have to accept complete accuracy as an obligation or quote other modifying influences like shape factor, leakage reactance and so on.

This is precisely what happens and, in actual fact, there are so many factors which influence the final result, and they are so inter-dependent that it is pretty well impossible to resolve them all mathematically and with complete accuracy.

As a result, empirical formulas and tables are evolved which give results correct to many decimal places or to the limits of reading accuracy in a graph or to a stated figure of accuracy. These references then qualify as "theory" for most of us by coming into the classification I suggested last month of "book learnin'."

Therefore, an inaccuracy of one part in a thousand is completely consistent with the expected results.

OHM'S LAW

(3) Fearing that it might be disproved, I have never been game to check Ohm's law with highly accurate equipment. Would an error, in fact, show it to be at fault?

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Winning on all counts from functional perfection and inherent quality to the fine finish—it is individually built for a rugged lifetime of service and completely equipped for the New Era in Electronics. It supersedes Multimeters.

Quickly it finds the most elusive intermittent, noisy, open or short circuits.

Easily operated without fumbling, it is an absolute necessity to all busy radio men. Works from 230 to 260 volts A.C. supply independent of line fluctuations.

Accurately Calibrated in separate colours on a 4" square dial (mounted in sloping panel) are direct readings on all tests, including: All Voltages, Resistors, Condensers, Coils, Transformers, Valves, Speakers, High Resistance Leaks and Faulty Insulation, up to 1000 megohms. Has both internal and external diode.

Versatility plus sensitivity, enable testing and checking of all circuits: A.F., R.F., U.H.F., and A.V.C., under operating conditions—without disturbance.

The R.E.L. Instrument will read A.C., D.C., and—D.C. volts with input impedance over 10 megohms, for all D.C. ranges and only slightly less for A.C. ranges.

High Resistance D.C. Voltmeter

0 to 3v	0 to 10v	0 to 30v
0 to 100v	0 to 600v	0 to 1800v

A.F., R.F., and U.H.F. A.C.! Ranges

with internal diode or external probe.

0 to 3v	0 to 10v	0 to 30v
0 to 100v	0 to 600v	

Resistance five ranges from 0.2 ohms to 1000 megohms.

N.B. Developed by specialisation, the Robinson Electronic Multimeter is individually constructed and not mass produced. With each instrument is a written guarantee which covers all components for a period of six months.

Telephone UA 1154

ROBINSON ELECTRONIC *Laboratories*

REL

107 PARRAMATTA ROAD. HABERFIELD N.S.W.

NEAR LIVERPOOL ROAD. **OPEN SATURDAY MORNING**

Now that's the sort of question I like, because it can be answered with a flat and ungracious "no."

Ohm's law establishes certain relationships by definition and it's up to us to make it work out "in practice." The boot is now very much on the other foot.

In one form, Ohm's law states that voltage drop of one volt will occur when a current of one amp is caused to flow through a resistance of one ohm. You see, the volt doesn't exist as a separate entity — it's the product of the other two. And so on round the circle.

If, in the process of measurement, something doesn't quite check, it simply shows up the limitations of our measuring devices or our definition of standards.

In just the same way there are 12 inches to one foot. If, perchance, we should discover 12.1 on a particular occasion, the answer is obvious.

(4) You said that theory could define how much distortion could be tolerated by representative groups of listeners. Assuming Dr. Olson increased the distortion of an amplifier in steps until the listeners noticed it, would he regard the results as "theoretical" or experimental?

Mr. Newbold, I admire you. (In the vernacular, you beaut!) You've got me sailing very close to the wind.

When you get right down to the proverbial tin-tacks, there probably isn't any real proven "theory" about psychological reaction to sound stimuli. Dr. Olson and his fellow workers can rely only on subjective tests, so that, in their origin, the observations have a practical basis.

"THEORY"

But having appeared as curves and tables in high-brow journals, they acquire the status of "theory" and are likely to be dismissed as such by the man who becomes obsessed by a pet amplifier and a two-guinea loudspeaker.

Mr. Harvey, of Ipswich, Qld., takes up the question of whether a listener has to be trained to enjoy high fidelity. My own observations on this score can be summed up this way:

(1) A true high fidelity system is technically not hard to listen to because it does not produce the rank and spurious distortion which characterises so many pseudo hi-fi outfits.

(2) Some may object to high fidelity in any form because it recreates sounds with which they are not familiar. In other words, having heard only the "radio" version of an instrument, the real thing is unfamiliar and possibly unacceptable.

(3) There may not be any moral obligation to know the original sound or to like it, either!

EAR TESTS

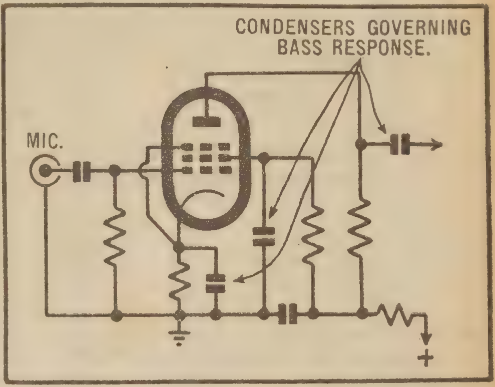
Mr. Harvey stresses the point that our ears have to be entertained, rather than test instruments, but few ears are capable of assessing what is or is not high fidelity. Adjust the amplifier for pleasing results, by all means, he says, but don't kid yourself that you can pick high fidelity unless you are musically educated. Mr. Harvey continues:

". . . amplifier cranks who have accustomed their ears to a false standard of reference should be taken into the concert hall and taught what real music sounds like. In this sense a process of education is necessary."

I am exhorted by this same reader to:

". . . turn a vitriolic pen against the type of amplifier crank, all too prevalent in this country, who uses his CRO, VT and distortion meter (albeit intelligently) and manages to produce something which is flat from here to kingdom come on voice coil voltage. He then proceeds to mount the speaker on a badly designed baffle, in a room of unknown acoustic properties and proclaims the result as the ultimate in sound reproduction."

Adequate condenser values in the position shown are needed to preserve low note response in mike amplifiers.



Maybe I will, Mr. Harvey, but I don't altogether like the phrasing of your request. It could contain a hidden barb, like the comment, "at least he's truthful."

All along, I've strongly supported the use of instruments because they alone can analyse and measure results quite objectively. They can tell you about peaks and troughs which the ear defines only as "shrillness," "lack of body" and so on.

But I agree that speaker and room acoustics are vitally important and unmeasurable as far as the normal enthusiast is concerned. Mr. MacKinnon, of Caulfield, Victoria, also takes up the question of speakers and baffling. Even so, there is everything to be said for using instruments up to the voice coil and banishing at least some of the unknowns. After that, you're on your own.

Perhaps I can suggest a few elementary rules about speakers which might put some erring enthusiast on the right track.

(1) Big speakers up to about 12 inches diameter are generally better than little ones. They have a lower cone, resonance and can move more air at low frequencies without running out of magnetic gap.

(2) Avoid thin baffles and thin cabinets like a plague. No baffle or cabinet should be less than ¾-inch thick, preferably thicker.

(3) Flat baffles 3 and 4ft square won't do any speaker justice. Mounting across a corner helps, but that's all.

(4) A big solid console cabinet makes a fair sort of baffle. Treat the inside with absorbent material to damp resonance effects.

(5) Vented enclosures are the best proposition for home listening because they are easy to build and not too critical in dimensions.

(6) Put your speaker in a corner position and give the sound a clear run toward the seating in the opposite corner.

(7) Banish "rattly" ornaments and three-ply panels—in fact anything that is likely to buzz or boomp.

(8) Go mainly for soft furnishings and floor coverings. "Hard" rooms are noisy and they're not good for concentration.

A country reader, Mr. C. Gates, takes up the question of reproduction level and says. . . .

". . . it is important to eliminate distortion as far as possible and to deliver the sound to the ear as close as possible to its original level."

Mr. Gates apparently has the right idea but there's a lot of people who haven't. How often have I heard it said that radio reproduction can never be lifelike, because it is always a miniature version of the real thing. That you would need amplifiers with hundreds of watts of output to give the same volume of sound as the original orchestra or grand organ.

Perhaps you would, but you'd also need your own private civic hall to do your listening in!

I agree that a single mic. and speaker channel cannot give true spatial reproduction but that's another subject altogether. Keeping to the original theme, the important thing is not the total radiated power at all, but the sound pressure at your ears. If you like to wear a decent pair of headphones, you can get wide range reproduction of music, using a few milliwatts or power and at the same volume as any listener in the hall.

EFFECT OF DISTANCE

Of course, if you use a loudspeaker, "loosely coupled" to the ears, more power is required, depending on the size of the room. But it still isn't hard to get the same degree of loudness as you would in the hall.

A second statement by Mr. Gates has to be taken with a grain of salt:

STANDARD FERGUSON RANGE

POWER & VIBRATOR TRANSFORMERS

	A.C.	Vib.				Retail
PF 122	240	6	220	40	6.3V @ 2A	33/6
PF 125	240	6	250	60	6.3V @ 2A	43/-
PF 119	240	6	325	125	6.3V @ 4A	62/-
PF 182	240	12	200	40	12.6V CT @ 1A	33/6
PF 126	240	12	250	60	12.6V CT @ 1A	47/6
PF 146	200,80,40	12	325	150	12.6V CT @ 2.5A	67/-

FILTER CHOKES

	Induct	D.C. Res.	M.A.	
CF 100	50	1900	10	18/-
CF 101	30	870	25	18/-
CF 102	15	300	60	12/-
CF 103	30	420	60	26/-
CF 104	30	580	75	31/-
CF 105	15	250	80	24/-
CF 106	12	200	100	24/8
CF 107	30	360	100	34/8
CF 108	12	135	150	35/-
CF 109	20	225	150	37/8
CF 110	12	100	200	43/8
CF 111	16	165	200	45/10
CF 112	10	70	250	46/2

SPECIAL CHOKES

CF 113	.5 20	70	250 50	Swinging choke	50/6
CF 114	1.1	23	375	Ballast choke	24/-
CF 115	.017	.6	2 amps	L.T. choke	10/-

OUTPUT TRANSFORMER TO VOICE COIL

Full Frequency Range (30-15000)

Code No.	Pri. Imped.	Sec. Imped.	Watts	Retail
OP24	5000 SE	8.4, 2.1, with feed back	5	44/10
OP23	3250 SE	12.5, 8.4, 2.1	10	65/1
OP19A	5000 PP	12.5, 8.4, 2.3	15	102/10
OP51	4500 PP	15.5, 12.5, 8.6, 2.7, 2	20	90/-
OP63	10000 PP	15, 3.75	15	100/-
OP64	10000 PP	12.5, 3.125	15	100/-
OP65	10000 PP	8.4, 2.1	15	100/-

OUTPUT TRANSFORMER TO VOICE COIL

Special Full Frequency (20-30,000)

OP25/40	10000 PP	40, 10	15	130/-
OP25/16	10000 PP	16, 4	15	130/-
OP25/15	10000 PP	15, 3.75	15	130/-
OP25/12	10000 PP	12, 3	15	130/-
OP25/10	10000 PP	10, 2.5	15	130/-
OP25/8.4	10000 PP	8.4, 2.1	15	130/-
OP66	5000 PP	8.4, 3.7	15	130/-
OP67	5000 PP	15, 6.5	15	130/-

OUTPUT TRANSFORMER TO LINE—

Full Freq. Range.

OP22	3250 SE	500, 125, 8.3	10	65/1
OP19b	5000 PP	500, 250, 125	15	102/10
OP21	8000 PP	500, 250, 125	15	82/10
OP62	10000 PP	500, 125	15	100/-

OUTPUT TRANSFORMER TO LINE—

Special Full Freq. Range

OP25/500	10000 PP	500, 125	15	130/-
OP25/250	10000 PP	250, 62.5	15	130/-

VIBRATOR TRANSFORMERS

Code No.	Pri. V.	D.C. Out.	MA	Buffer Full Sec.		
VT 100	32	200	40	.005	Sync.	27/-
VT 101	6	90	15	.008	”	19/6
VT 102	6	150	25	.005	”	23/10
VT 103	6	200	50	.005	”	25/-
VT 104	6	250	60	.005	”	37/-
VT 105	12	250	60	.005	”	37/-
VT 106	6	300	75	.008	”	52/-
VT 107	6	250	60	.005	Sync. Low Rad.	30/6
VT 108	12	90	15	.008	Sync.	21/8
VT 109	24	90	15	.008	”	23/8
VT 110	12	150	25	.005	”	23/10
VT 111	24	150	25	.005	”	26/6
VT 112	12	200	50	.005	”	25/-
VT 113	24	200	50	.005	”	26/6
VT 114	12	300	75	.008	”	54/2
VT 115	24	300	75	.008	”	55/6
VT 116	24	250	60	.005	”	30/-
VT 117	12	250	60	.005	Non Sync. Low Rad.	31/-
VT 119	32	150	25	.005	Sync.	25/6
VT 121	6	180	30	.005	”	25/4
VT 122	6	400	50	.005	”	50/-
VT 123	12	320	125	.005	Sync.	63/3
VT 124	32	250	60	.005	”	30/-
VT 127	6	200	50	.005	Sync. Low Rad.	29/8
VT 128	12	250	60	.005	Sync. Low Rad.	38/-

RECEIVER POWER TRANSFORMERS

Code No.	Prim.	HTV Aside	M.A.	Filaments	Retail
PF 185	240	150	30	6.3V @ 2A	21/-
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	30/-
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	30/-
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	34/-
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	34/-
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	46/-
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	46/-
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	56/-
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	66/-
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	60/-
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	70/-
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	110/-
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	111/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3 @ 3A, 5V @ 3A	144/-
PF 201	240	225	50	6.3 @ 2A	29/11

LINE TO VOICE COIL TRANSFORMERS

	Pri. Imped.	Sec. Imped.	Watts	
MT111	500	12.5, 8, 2.3	10	36/9
MT100	600	4, 3	15	36/9
MT101	500	15	15	36/9
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	66/-
MT125	600, 500	15, 12.5, 8.4, 6.5	25	66/-

MODULATION TRANSFORMERS

MT118	8000, 6000 PP	10000, 7000 5000	25	85/-
MT119	8000, 6600, 3800 PP	10000, 7500, 6500 5500, 4500, 3500	50	111/-
MT120	500 to 20000 in steps.	500 to 30000 in steps.	50	200/-
MT121	500 to 20000 in steps.	500 to 30000 in steps.	125	276/-

Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	39/10
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	10	45/8
OP39	5000, 2500 SE	15	10	39/10
OP33	5000, 2500 SE	5, 2.7	10	39/10
OP41	5500 SE	3.7	10	46/-
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.3	10	36/9
OP2	5000 PP	12.5, 8, 2.3	15	65/1
OP55	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP3	6600 PP	12.5, 8, 2.3	15	65/1
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP4	10000 PP	12.5, 8, 2.3	15	65/1
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	65/1
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3 2.7, 2.3, 2	15	76/2
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	93/8
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	32	116/8

OUTPUT TRANSFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	39/10
OP44	5000, 2500 SE	500, 250, 125	10	47/-
OP34	5000 PP	600, 300, 200, 150, 130, 100 75, 50	15	81/4
OP6	5000 PP	500, 250, 125	15	65/1
OP7	6600 PP	500, 250, 125	15	65/1
OP50	8000 PP	600, 300, 120, 60, 30	15	126/-
OP8	10000 PP	500, 250, 125	15	65/1
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50	15	71/3
OP9	10000, 6600, 5000 PP	500, 250, 125	15	65/1
OP10	5000 PP	500, 250, 125	25	81/10
OP11	6600 PP	500, 250, 125	25	81/10
OP38	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7	25	140/-
OP12	10000 PP	500, 250, 125	25	81/10
OP13	10000, 6600, 5000 PP	500, 250, 125	25	81/10
OP35	10000, 6600 PP	500, 4000, 8.4, 2.2	25	120/-
OP14	5000 PP	500, 250, 125.	32	102/10
OP48	6600 PP	140, 70.	32	117/8
OP15	6600 PP	500, 250, 125	32	102/10
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	104/1
OP16	10000 PP	500, 250, 125	32	102/10
OP17	10000, 6600, 5000 PP	500, 250, 125	32	102/10
OP36	3800 PP	17.6	60	108/7
OP18	3800 PP	500, 250, 125	60	108/7
OP61	3800 PP	100, 75, 25, 10, 5, [illegible]	60	133/8
OP37	6400 PP	500, 250, 125	80	150/8
OP49	8800, 6000 PP	500	105	210/-
OP20	11600, 8400 PP	500, 250, 125	150	276/-

ALL PRICES SUBJECT TO ALTERATION WITHOUT NOTICE

"Let me remark that what may be high fidelity at ten feet may not be so at twenty feet . . ."

He then goes on to point out, quite rightly, the difference in reproduction at varying sound levels and listening distances. But what a lot of hooey is talked about all this!

The classic research along this line was done by Fletcher and Munson, who produced a set of curves showing the relationship between sound pressure, the sensation of loudness and frequency.

When listening to fairly loud music, the ear shows a more or less even response at all frequencies from 30 odd c/s to its top limit somewhere over the 10Kc. mark. But let the volume be reduced and the ear begins to miss out badly at both ends of the spectrum until, down near the threshold of hearing, it only perceives the middle frequencies.

The effect is a purely physiological one and has nothing to do with electrical reproduction. You hear more bass and treble close up to the band than you would a quarter-mile back up the road. In fact, over that distance, you'd probably hear only the middle frequencies. But could one fairly say that the "fidelity" of the band varied with distance? Or what hall is officially divided up into high, medium and low fidelity seating, depending on distance from the stage?

Precisely the same rule holds for the volume setting on your amplifier. Turn the gain up and, if everything is properly balanced, you'll hear plenty of bass and treble. Turn it down to a whisper and you seem only to have the "middles" left. As far as your ears can tell, you're simply listening to the same sound over a greater distance.

The whole effect has given rise to some rather ludicrous statements. For example, I have been told quite seriously that it is a mistake to use a big amplifier in a small room because operating it at low volume "spoils the tone." One is said to get much better results from a small amplifier operating nearer its maximum power limit. Phooey again!

Provided the designer hasn't done anything silly, the response of an amplifier is (or should be) independent of the volume control setting. What's more, other things being equal, a big amplifier cut well back is likely to have a lot less distortion than a small one turned well up.

DEMONSTRATIONS

I'll tell you what really does happen. The big amplifier is invariably turned up by the demonstrator to show off its output. In so doing, the listener's ears are run into their linear response region, where they hear all the bass and treble to advantage. When the gain is turned down again, the bass and treble seem to fall away sharply and the set-up sounds pretty poor by contrast.

A small amplifier simply cannot be turned up in the same way and there is no chance of establishing a false standard of reference. In other words "What you never have, you never miss. . . ."

But whether the process raises or lowers the fidelity is a moot point. It makes audible something you want badly to hear, something you would normally miss, but something you shouldn't hear anyhow at low volume!

You can argue the rights and wrongs of this as long as you like but, as far as I'm concerned, I'll continue to apply the requisite boost when I look like missing out on something. But enough of all this! (He's right, too! Matter of fact, we call him "tone control Williams," among other things—Ed.)

Getting back to circuitry, I want to take a crack at many of those who spend their waking hours designing, building and installing public address systems. Partial as I am to electronic devices, I still can't help being affronted by the efforts of others to reinforce the human voice.

Let me ask a simple question. How often have you heard a P.A. system which retained the qualities of the speaker's voice? Never? Well hardly ever?

Let's admit that clarity is important Let's admit that it is even paramount at sports meetings and railway stations but that's not the end of

(Continued on Page 73)

ELECTRONIC
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EQUIPMENT

With quality as the prime factor A & R products are developed to give lasting and highly satisfactory performance. We market our transformers to satisfy the needs of the customer who buys on value and not on price.

At present the accent is again on high fidelity audio reproduction and with the advent of wide range disc and tape recording together with pickups and speakers, better-class equipment is required to fully utilize these wide range components.

Aware of these requirements, we have for quite some time been manufacturing wide frequency range audio transformers for almost every purpose. Our catalogue of Transformers and Reactors which may be obtained on request gives a large selection to choose from; whether the requirements be for Audio, Radio, Theatre, Domestic or Industrial use.

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378 ST. KILDA ROAD, MELBOURNE, S.C.1
Phones: MX1159, MX1150

Here's your answer, Tom!

Another lad in his teens, our "Tom" for this month has only recently started high school. He was unfortunate enough to catch the radio fever when exposed to his first few science classes. The course of the disease has not been passive and the fever has gradually been increasing in intensity, not only to his own anguish, but to the discomfort of all around him. We are asked to help him over the crisis.

THE school dictionary, it would appear, is largely to blame for Tom's present dilemma. It merely lists a condenser as a "device for liquefying gases or vapour." Naturally, Tom hasn't been able to reconcile the idea of grandpop's whisky still, hidden in the gully, with the device which seems to play such an important part in radio.

A CONDENSER

What is a condenser as applied to radio and could you please suggest a reason for its being so called?

It's a bit tough, having to make up the deficiencies of your dictionary, Tom, but we can perhaps be of some assistance.

A radio condenser consists of two conductors separated by an insulator which is commonly referred to as the "dielectric." The conductors may be metal plates, metal foil or even wires while the insulating dielectric may be air, mica, paper or, in the case of electrolytic condensers, an extremely thin film of aluminium oxide.

In all cases, the capacity of the condenser can be increased by increasing the area of the plates or decreasing the thickness of the dielectric. The minimum thickness of the dielectric is set by the maximum voltage the condenser is required to withstand.

A condenser is a device for storing energy in electrostatic form. The people who first applied the term probably thought of the electricity being stored in a more compact, or more condensed form. We agree that the term is a little vague but it was applied when people knew comparatively little about electronics.

If you like, you can picture a condenser collecting and storing electrical energy in the same way that grandpop's aforementioned "still" collects the whisky vapor. However, a more conventional and perhaps a more satisfactory analogy is that of a spring. If you compress a coil spring and hold it in compression, you are actually storing energy in the spring and that energy can be reclaimed, when required, simply by releasing your grip on the spring. This is exactly the action that takes place in the wind-up toy trains, so beloved to young sons and old fathers.

ENERGY STORE

The analogy about the spring is really very good because, as few people realise, there is actually a mechanical tension between the plates of a condenser when a charge is applied.

The condenser in the filter of a radio receiver collects and stores electrical energy when there is some to spare and delivers it back into the circuit when there is a deficiency. It therefore tends to keep the level of the electrical tension, or voltage, constant. The springs in a motor car do much the same thing in a mechanical sense. They absorb the irregularities of the road and allow the body to ride evenly and smoothly. (That's the sales story, anyway, Tom.)

The charging and discharging action of a condenser is often employed in radio sets to allow coupling for alternating currents, while preventing the passage of direct current. If a steady direct current is applied to a condenser it will charge and remain charged until the supply is removed. If, however, an alternating voltage is applied at the same time, a condenser of the right size will pass on the alternating voltage and block the steady voltage.

I have noticed that you frequently mention, variable condensers, mica condensers, paper condensers and electrolytic condensers. What is the reason for so many different types?

It's all a matter of the right component for the particular job. For instance, you wouldn't use one of the 6 inch diameter bolts from the Sydney Harbor Bridge to hold together the parts of a mecanno set.

Neither would you use a 16 mfd electrolytic condenser, which is intended for filtering the 50 cycle a-c power mains, for coupling together two stages of a transmitter at 50 megacycles where a condenser of about .0001 mfd. would be adequate.

The various types of condensers you have mentioned are simply convenient ways of producing a particular capacity in a practical form.

PAPER CONDENSERS

It is convenient to make condensers of from practically zero capacity to about 0.01 mfd with a mica dielectric. Above this value, mica condensers tend to become awkward and expensive and paper is frequently used as a dielectric for condensers of from about 0.001 to 1 mfd capacity.

Paper condensers of greater capacity than this are used for special purposes, such as in transmitters, but they will probably not concern you for some time to come.

Where high capacity is required for receiving work, it is convenient to use an "electrolytic" condenser, which has a dielectric of exceedingly thin aluminium oxide, formed by a chemical action. These condensers have a breakdown voltage which is a function of the thickness of the oxide film and invariably allow a certain small leakage of current. However, since they are used normally for filtering, bypassing cathodes and other applications about which you will learn later, this is not of any great importance. They certainly do save an enormous amount of space.

If you decide to substitute paper condensers for all the electrolytic condensers in the family five-valve set you would need an extra large chassis to carry them all. You would be able to point out very proudly that every condenser was perfect and did not show any leakage resistance but, unfortunately, nobody would be able to notice the difference.

Variable condensers are nearly always required to have only a relatively small capacity and it is feasable to construct a condenser of reasonable proportions with air as a dielectric. Capacity can be varied, either by varying the separation of the plates or by varying the area of the plates adjacent to each other.

CONDENSERS

What is the difference in function between an electrolytic condenser and the ordinary tubular paper type? I notice in the "EF50 Four" you have a .1 mfd condenser connected in parallel with an 8 mfd electrolytic. Surely the .1 mfd would make a negligible difference.

Apparently, Tom, you have allowed this condenser business to really get you down but the explanation is quite simple.

Electrolytic condensers are excellent bypasses for audio frequencies but do not work particularly well at radio frequencies. This is often proved when an unstable set is cured by connecting a small paper condenser from the B-plus line to earth. We normally include the extra condenser as a standard item.

If you ask the expert why an electrolytic condenser is not a good R. F. bypass he will start a long dissertation on inductance of leads, power factor etc, but he can have fun and games on his own for the time being.

CRYSTAL DETECTORS

A friend of mine tells me that I can get louder volume from my crystal set by attaching a battery to the crystal. Is this correct?

No. That is, unless you happen to be using one of the old type carborundum detectors. These worked best with a polarising voltage of about 1.5 and sets using them often incorporated a couple of small cells and a potentiometer, so that the polarising voltage could be adjusted for the greatest volume.

These days, crystal set fans usually favor galena, which your science teacher will know as lead sulphide. It is often found in silver-lead mines in the form of grey cubic crystals and makes an excellent detector for radio work. A chunk of the crystal is usually held in a small metal bowl with a set screw and this forms one terminal of the detector. Contact with the crystal is made with a small piece of fine wire known as a "catswhisker." An adjustable bearing allows the catswhisker to touch on the crystal at the most sensitive spot.

Crystals are by no means obsolete and, although their external form has changed, the devices which are now used in V.H.F. radar gear etc, are essentially similar to the humble galena/catswhisker arrangement.

These crystals are made with germanium or silicon as the element, depending on the characteristics required. The adjustment of the whisker is sealed, usually by some form of wax and will hold its adjustment, even when subjected to quite considerable vibration. Furthermore, due to advanced manufacturing methods, they are considerably more sensitive than their predecessors.

If you are lucky enough to get hold of one of these crystals be especially careful not to overload it. A battery connected across the element would almost certainly ruin it.

My crystal set is working very well but I would like a little more volume. What do you think of the amplifier circuit I have enclosed?

(Tom encloses the circuit of a device which consists essentially of a headphone mechanically coupled to a carbon microphone button with an exciting battery.)

If you are keen on making Bing Crosby sound like Paddy McGinty's goat, by all means go ahead. These devices certainly amplify but that is about all. For a start the headphone has a peaky frequency response characteristic and a limited range but the characteristics of the carbon microphone are likely to be much worse. It will introduce a serious peak within the range, a high degree of harmonic distortion and hiss caused by minute arcs between the carbon granules.

CARBON PACKING

Added to this, the pressure on the carbon button requires critical adjustment and due to "packing" it is necessary to readjust it fairly frequently.

Some of the older type valves can be obtained from the "arcade" radio dealers for a couple of shillings or so and about the simplest and most satisfactory way to obtain more volume from a crystal set is a one valve amplifier along the lines of that described in the June 1949 issue.

Later on, when you have gained sufficient confidence you can drop the crystal and use the parts from the amplifier to make a one valve regenerative job which will give even better volume and very much improved selectivity. We published a suitable circuit in the December 1947 issue of Radio and Hobbies and can let you have a copy through the shilling query service.

In the meantime, Tom, don't neglect the Maths. and History.

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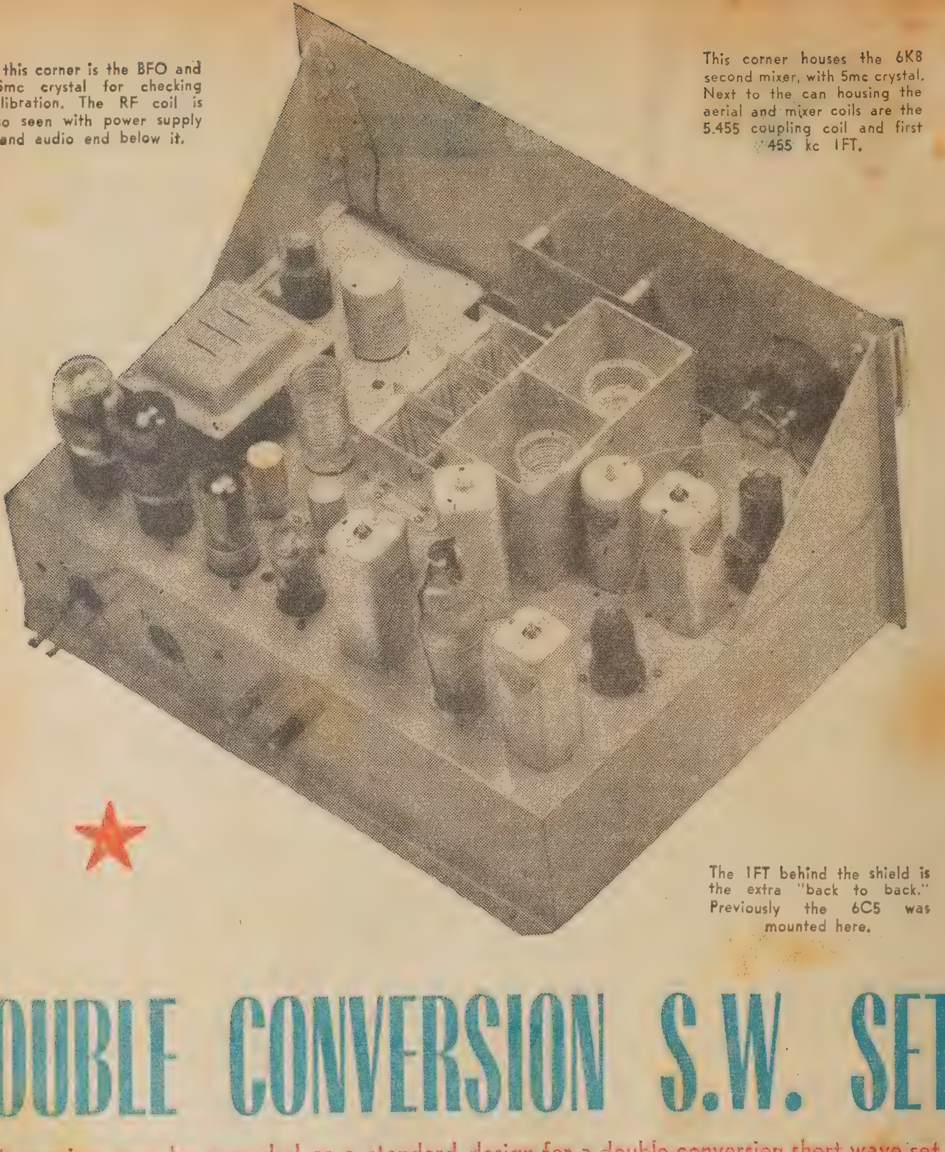


In this corner is the BFO and 3.5mc crystal for checking calibration. The RF coil is also seen with power supply and audio end below it.

This corner houses the 6K8 second mixer, with 5mc crystal. Next to the can housing the aerial and mixer coils are the 5.455 coupling coil and first 455 kc IFT.

The IFT behind the shield is the extra "back to back." Previously the 6C5 was mounted here.

DOUBLE CONVERSION S.W. SET

This receiver may be regarded as a standard design for a double-conversion short wave set, either for amateur or short wave work. It is a little more complicated to build than a straight receiver, but gives an exceptionally good performance.

AMONG the short wave receiver circuits given in the last Australian Short Wave Handbook was one for a double conversion job using plug-in coils and intended primarily for amateur work.

Unfortunately the space available in the Handbook was not sufficient to give full details of the receiver as we generally do in an article of this kind. In response to many requests, as the saying goes, we present the circuit here with further information on the receiver itself.

Most builders of the larger type of short wave sets are able to get very good results from them. The standard way of going about the job is to prepare something with an RF stage, generally two stages of 455kc IF amplification, and various elaborated audio ends.

Such a receiver was the De-luxe Eleven Valve set described some little time ago, which in turn grew from a smaller eight valve set built on the same chassis and with essentially the same components. This chassis, used again here, is known as the "Communications Nine."

The eleven valve circuit used two IF amplifiers, but six IF transformers connected "back to back" for extra selectivity. Using a layout similar in essentials to the set shown here, we used these jobs consistently in 7, 14 and 28 mc. and found them very good. So good that it is hard to visualise any variations which are likely to produce better results. We even compared them with a number of highly-rated communications receivers only to find that in sensitivity and noise level they compared more than favorably, mainly because of their vastly better L/C ratio on the bands being used. This was only natural because the normal communications receiver is called upon to give continuous coverage, and cannot be expected to pace it on selected bands against a set where coils are specifically designed for them.

Not that these sets of ours were restricted to spot bands. By using a large enough oscillator bandset, and large enough hand trimmers on aerial and RF circuits, they could be made to give about a 2-1 coverage, or by sacrificing bandspread and using a larger tuning gang, even greater coverage than this with a hand-calibrated dial.

PLUG-IN COILS

The only disadvantage, if it can be so termed, is that the coils were "plug-in," necessitating a minute or two delay when changing various wave bands. With the inclusion of a crystal oscillator producing spot frequencies—for amateur use a 3.5 mc. crystal was used — quick and accurate lining up of each set of coils was possible each time they were changed, thus removing the greatest bugbear of plug-in coils, that of lining them to the dial after a change has been made.

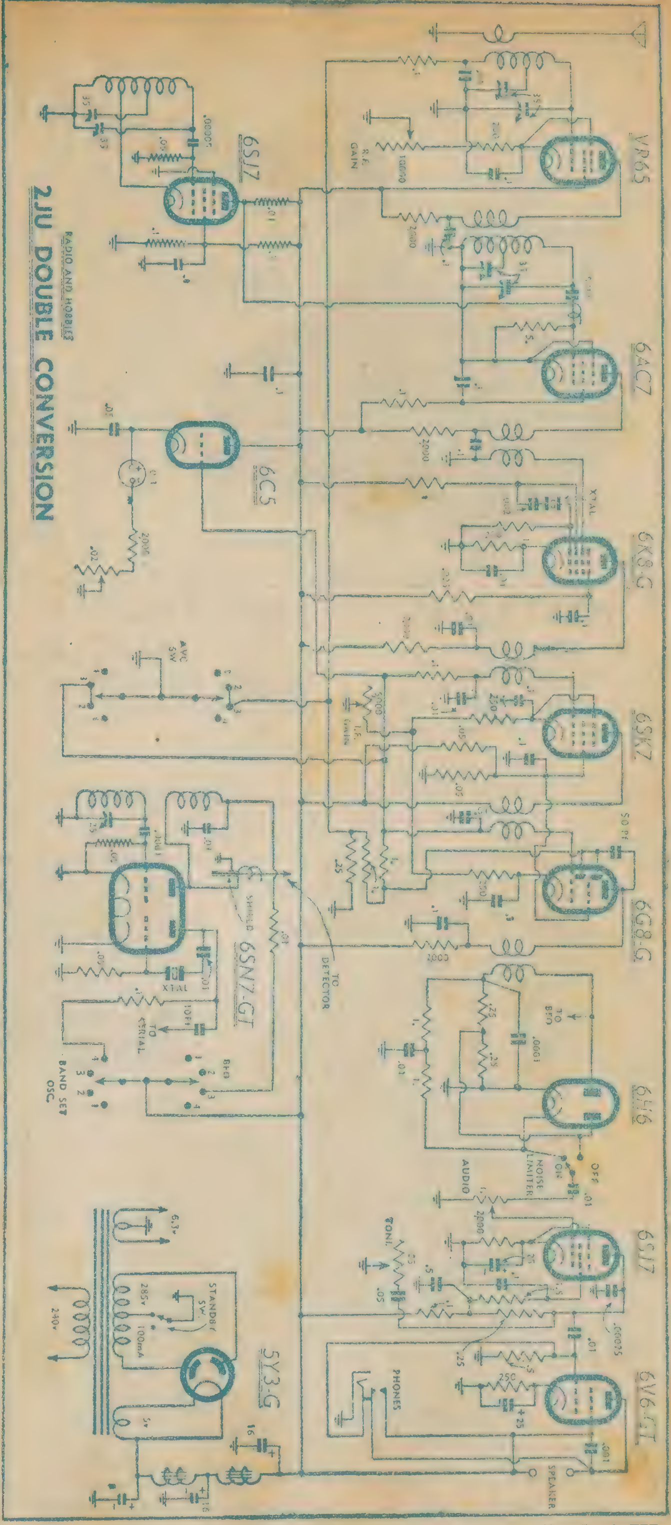
The amateur set thus had available a strong carrier from the oscillator on 3.5, 7, 14 and 28 mcs, nicely placed for this purpose, but almost any frequency would do for a continuous coverage set as long as its spot is marked on the dial when calibrating.

To cut the story short, sets of this order provide as much gain as is generally required even at 28 mc., and by suitably elaborating the IF channel on the lines indicated, selectivity adequate for all purposes short of the crystal filter standard adopted by some CW enthusiasts.

Even here, however, the tendency now is to use very selective IF channels with frequencies of 100, 85, or 50kc. But, we begin to run into the drawbacks of any set using single conversion, namely oscillator pulling and double spotting or poor image response.

DOUBLE SPOTS

This nuisance is primarily a function of selectivity ahead of the mixer valve. With a single RF stage there are only two such circuits. These cannot provide enough selectivity, particularly at the higher frequencies, to discriminate against strong stations spaced twice the IF away from the station being received.



The circuit omits the extra IFT and shows the preferred "S" meter connection. The circuit shows how RF gain and tone controls are fitted.

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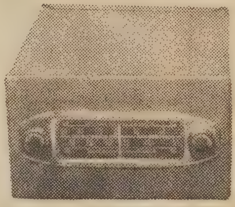

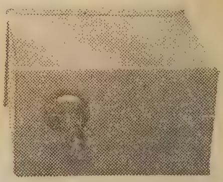

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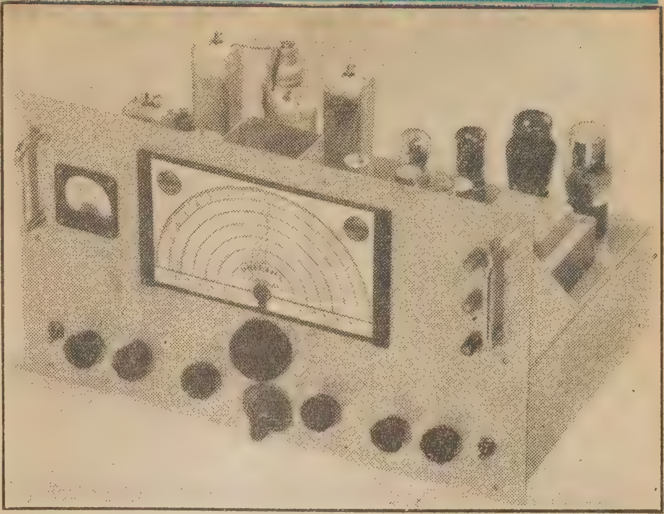
FRONT PANEL OF RECEIVER



Controls left to right are standby switch; function switch; IF gain; mixer trimmer; Osciilator Bandset aerial trimmer; audio gain; BFO pitch control; noise limiter switch.

Even the use of two RF stages doesn't entirely remove the trouble, apart from the need for a four-gang condenser and the lining up of four circuits.

A double conversion circuit, on the other hand, allows virtual freedom from double spotting, eliminates the pulling problem, and can be made to give almost any degree of selectivity according to the choice of the second IF.

Broadly speaking, such a set uses a first IF channel much higher than 455kc. In our set it is 5.455 megacycles. This means that the images now fall twice this figure from the channel being used—nearly 11 megacycles away. It would be a very poor set which couldn't separate signals at this distance.

The output of this first mixer feeds into another mixer which changes to a frequency selected for selectivity. It is now quite practicable to use almost any IF here, providing the coils are selected to suit.

In our case we did not require crystal-sharp tuning. We were satisfied if we could work within three or four kc of a strong signal, which means tuning out even strong locals over a band six or seven kc wide. This is rather a rough way to estimate selectivity, but it does give an idea of what is meant.

Thus our second IF channel used the convenient 455kc frequency with a set of high-selectivity transformers which did about as well as five standard types arranged "back to back." Since the set was first made we have added a fourth IFT of the same type between the IF amplifier and second detector "back to back," giving tuning quite sharp enough for excellent phone station separation without too much side-band cutting.

New let us see how all this works out in practice.

THE TUNER

The RF end of the set is centred around a standard broadcast gang in which the moving plates have been removed, cut down to three small double-spaced plates for each section and re-assembled. The exact size of these plates doesn't matter, but a more stable job is obtained with three small plates than by one full-sized one. Band spread is obtained by tapping the condenser sections down the coils to get the right bandspread. This also ensures the minimum gang capacity appearing across only a small portion of each circuit.

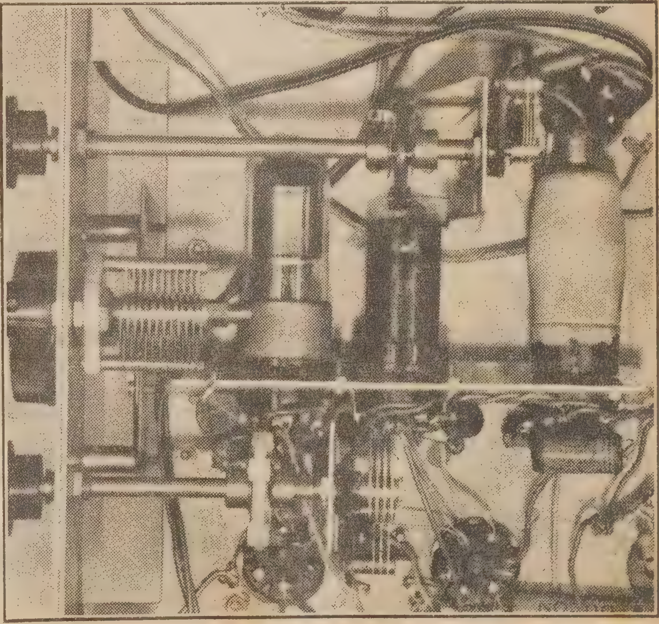
The coils plug in from the top, and to keep connections short the RF amplifier, first mixer and oscillator are mounted on their sides beneath the gang under the chassis. They are thus handy for connection to the hand trimmers, symmetrical placement of which is one reason the RF coil is on its own away from the others. This also simplifies shielding. Only the mixer and oscillator coils are shielded by mounting a simple lidless box around them.

R.F. VALVES

The RF amplifier will have short leads if a double-ended valve is used. The VR65 is about the best choice here. It is a valve not fully appreciated for its excellent performance on these bands. A single-ended valve such as the EF50 can be used by mounting it on a separate bracket between the aerial and mixer coils. The longer leads are not vitally important at these frequencies, and we have used this valve successfully in earlier models.

The 6AC7 theoretically is the best mixer, but here again most of the high slope pentodes will work equally as well. We like a pentode oscillator as being particularly stable. A high slope valve here is often not as good as one of the 6SJ7 class.

This first mixer feeds through a home-made transformer into the second mixer, which is a 6K8 or similar valve. There is no point here in using a separate oscillator. The



Details of the 5.455mc coupling coil made from a 455kc IFT.

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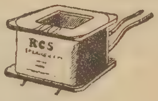

14/60 Filter Choke Type TC66. Retail	10/-
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COIL DATA

3.5 Mc.

R.F. coil: Primary 10T closewound; secondary 40T closewound, tap 26T.
Mixer coil: Primary 14T closewound; secondary 40T closewound, tap 26T.
Oscillator coil: 12T spaced to 1½in., tap7T., cathode tap 3T.

7 Mc.

R.F. coil: Primary 8T closewound, secondary 23T spaced to 1½in, tap 8T.
Mixer coil: Primary 6T closewound, secondary 23T spaced to 1½in, tap 8T.
Oscillator coil: 8½T spaced to 1¼in, tap 2T, cathode tap 2⅓T.

14 Mc.

R.F. coil: Primary 5T closewound; secondary 12T spaced to 1½in, tap 3T.
Mixer coil: Primary 6T closewound; secondary 12T spaced to 1½in, tap 3T.
Oscillator coil: 10T spaced to 1¼in, tap 6T, cathode tap 2T.

28 Mc.

R.F. coil: Primary 3T closewound; secondary 6T spaced to 1½in, tap 1⅞T.
Mixer coil: Same as R.F. Coil.
Oscillator coil: 4T spaced to 1¼in, tap 2¼T, cathode tap 1¾T.

27 Mc.

Same coils as for 28Mc except that trimmers are set to different values.
All secondary windings are wound with 18 s.w.g. enamelled wire.
All primary windings are wound with 30 s.w.g. enamelled wire.
Primary windings are spaced ¼in from secondary windings in all cases.
All coils are wound on 1¼in dia. coil formers.

oscillator section of this valve is crystal controlled for maximum stability and ease of lining up. Our crystal was exactly 5 mc, but anything near this figure can be used.

As we chose to work on the high side of this second oscillator our second IF was 5.455 mc. This means that the home-made coil is really an IF transformer tuned to 5.455 mc. The mixture of this frequency and the 5 mc oscillator produces the 455 kc which now flows through a normal 455 kc IF channel.

If a lower IF were to be used the coupling coil would be tuned to 5 mc plus this frequency, and the second IF's selected to suit. If this should be 85 kc, for instance, the coil would be tuned to 5.085 kc and the second set of IF transformers would be on 85 kc.

With lower frequencies, however, you will find two stages about all you can easily handle, and things get really sharp. Two stages of 175 kc would be quite good, but we suggest you keep to the 455kc channel unless you have fixed ideas on the matter, particularly if you are building your first big set.

The beauty of doing so is that you can first get the set going as a straight 455kc job by connecting the 6AC7 mixer plate into the first 455 kc transformer, skipping over the 6K8 circuit altogether. Having lined up in this manner the 6K8 can be wired in, the plug-in oscillator coil rewound to the smaller size, and the home-made coupling coil peaked to resonance. It's not at all hard in practice—much easier than it sounds.

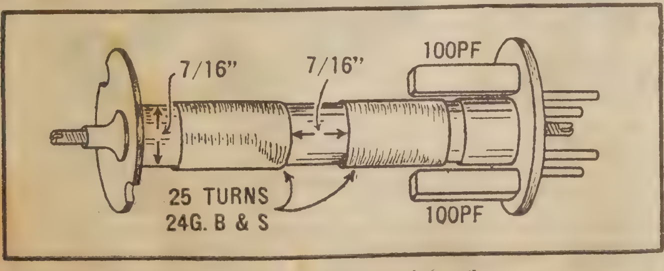
CRYSTAL CONTROL

Crystal control for the second mixer is strongly advised. Using the simple Pierce circuit, mixing is automatic; there are no coils to be wound or lined up, and one less vital adjustment is removed. A normal oscillator can be used, of course, but don't try it unless you have a good oscillator handy to set the frequency correctly. The crystal is sure-fire and you can forget troubles with the second mixer.

Do not stray too far from 5 mc. This oscillator will generate harmonics which can be tuned in by the set as strong carriers. For instance, this set has them at 10 mc and 15 mc, and so on. On the 28mc band one appears dead on 30 mc to make a handy marker for the end of the band! But obviously if you choose a crystal with a harmonic inside one of the bands it will be a pest. These harmonics are almost impossible to remove except by elaborate filtering and shielding not warranted in this set.

The rear end of the set is now almost conventional with us, as it provides AVC, noise limiting, beat oscillator, and crystal check oscillator with very few valves. The function switch allows for ordinary operation with AVC in the first position, cuts AVC in the second, adds BFO in the third, reverts to AVC plus the check

(Continued on Page 96)



Details of the 5.455mc coupling coil.

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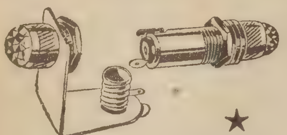

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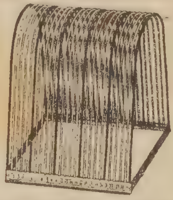

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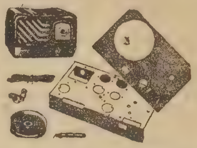

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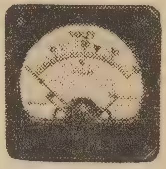

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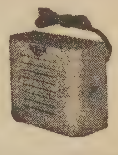

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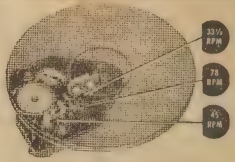

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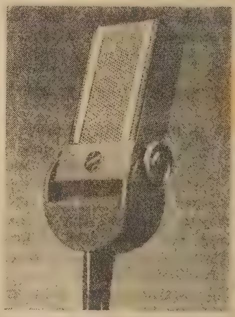

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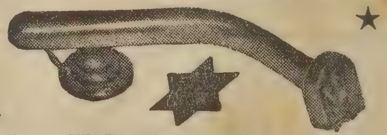

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PART 18—FRAME SYNCHRONISING PULSES

Having examined the process from which the line synchronising pulses are extracted from the composite signal, it now remains to examine the equivalent process which makes available the frame pulses. It is necessary to learn a new term, namely "integration."

ALTHOUGH the frame oscillator naturally operates at a much lower frequency than the line oscillator, the synchronising and precision of the oscillator is vitally important. In building up the picture, the spot must begin its slow downward movement at precisely the same instant that it begins its more rapid left-to-right movement to trace out the first line.

Having traced out exactly half the total number of lines — 202½, 212½ or 312½ according to the standards—the downward movement must cease and the spot be returned to the top of the picture to trace the interlaced lines.

INTERLACE

It follows, if the framing impulse leads or lags in random fashion by a period equal to half a line, that the proper interlace will not be produced. Instead, the odd lines and even lines will tend at times to overlay one another, reducing the effective line structure of the picture by a factor of 2.

It must be assumed that the timing pulses sent out by the transmitter are properly spaced, so that the requirement is imposed on the receiver to treat each framing pulse in exactly the same fashion. The circuit normally employed for the extraction of the framing pulse is known as an "integrating circuit."

CIRCUIT BEHAVIOUR

It is complementary to the "differentiating" circuit, already mentioned, and is essentially a resistance-capacitance series network, as in figure 1, with the output taken across the condenser (c). As such, it is an elementary low-pass filter and its action can be compared with the familiar R.F. bypassing and treble-cut circuits encountered in ordinary receivers and amplifiers.

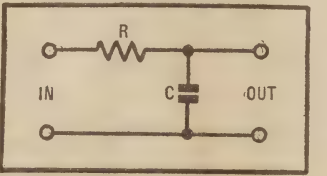

Figure 1. The fundamental integrating circuit. Output is taken across the condenser.

Applied to pulses, however, the integrating circuit is best looked upon as one which "adds up" electrical quantities—a function suggested by its name. Just how it behaves in relation to pulses of specific duration depends entirely on the time constant of the two components.

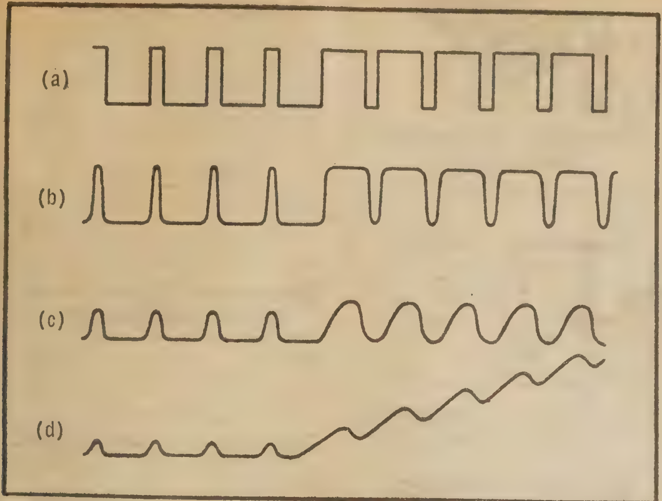

Figure 2. A series of timing pulses (a) and the effect of gradually lengthening the time constant. (c) is required pattern.

Figure 2a, illustrates a typical series of long and short pulses and the likely output from an integrator network having differing values of time constant. The illustrations should be compared with figure 2 last month.

TIME CONSTANT

Figure 2b is what would be expected with a very short time constant or, in audio parlance, with a small value of bypass and only a slight "top-cut" effect. This top-cut would remove the very high order components from the impulse, tending to round the corners and impart a definite slope to the ideally vertical sides. The figure does, in fact, approximate the shape of pulse which can be expected through a complete video system having a necessarily limited bandwidth.

Lengthening the time constant of the integrator circuit further increases the rise time to such an extent that the output voltage has not time to reach maximum amplitude before the downward pulse is encountered. Similarly the downward pulse ceases before the output can reach the full peak downward value. As a result, the brief line pulses are converted to a very much attenuated and rounded-off version of the original.

On the longer framing pulses, the same slow rise time is evident, but since the pulses are sustained over a longer period, the output has time to approach the full peak value before the downward excursion is encountered. The resultant output begins to lok rather like a badly-distorted sine wave.

LARGE CONSTANT

Once again, referring to audio terminology, it follows that if the harmonics of a rectangular waveform are removed progressively by a low pass filter, it will gradually assume sinoidal form, becoming completely so when the harmonics have been finally eliminated.

Figure 2d shows the effect carried

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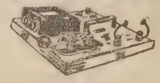

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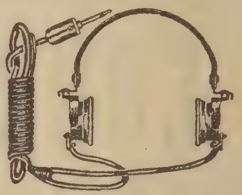

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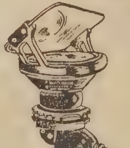

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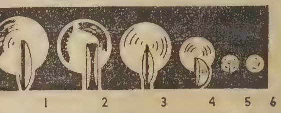

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a step further, the time constant being lengthened to such a degree that the circuit responds hardly at all to the brief line pulses.

On the longer framing pulses a new condition arises in that the condenser receives a charge during the first long pulse which it only partly loses during the brief interval between pulses. Thus, when the next long pulse arrives, the condenser begins to charge again but, this time, the starting point is well above zero.

The process continues as the successive long pulses are received until the condenser has acquired a charge which is substantially greater in value than the peak value of individual charging pulses.

Here then is one answer to the frame synch. problem, for we have a circuit which resolves a change in pulse length into a change in amplitude and which can therefore be applied to "trigger" the frame oscillator.

PULSE SHAPE

It is obvious that the exact shape of the framing impulse will depend on the time constant of the integrator circuit and the values must be carefully selected in relation to the pulse frequency and duration.

Figure 3 shows the initial network which might be installed in a television receiver to select the timing pulses. The input from the synch. separator stage is fed to a double R/C network made up from separate differentiator and integrator circuits. From these, respectively, emerge the synch. pulses for the line and frame oscillators.

The type of pulse produced by a simple integrator is not by any means ideal for triggering the frame oscillator, since the leading edge has a serrated, sloping form. This is responsible for some uncertainty as to the exact point in time when the frame oscillator is triggered, so that the accuracy of the interlace is likely to suffer.

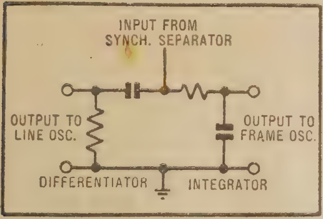

Figure 3. Complete network combining the differentiator (left) and the integrator (right).

Where some degree of complication can be tolerated, it is desirable to employ additional circuitry which will allow better separation of the line and framing pulses, also a more precise triggering action for the frame oscillator.

Two typical circuit arrangements are worthy of mention, representing distinctly different lines of approach.

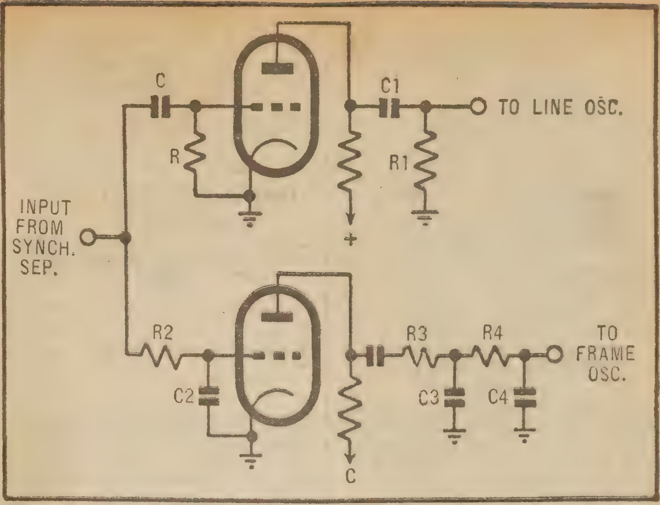

Figure 4. Illustrating one method of improving the synch. signals to the two oscillators.

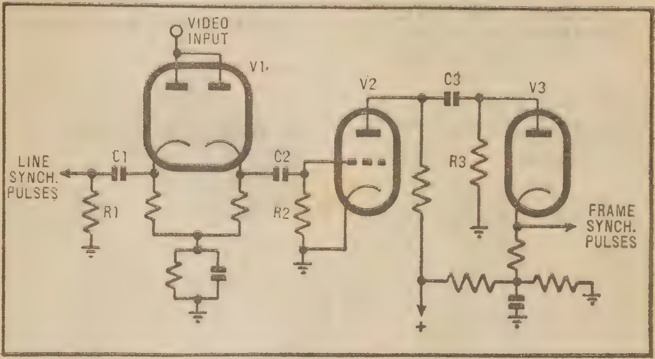

Figure 5. An alternative circuit which separates pulses from the composite signal and also provides a sharp frame synchronising pulse.

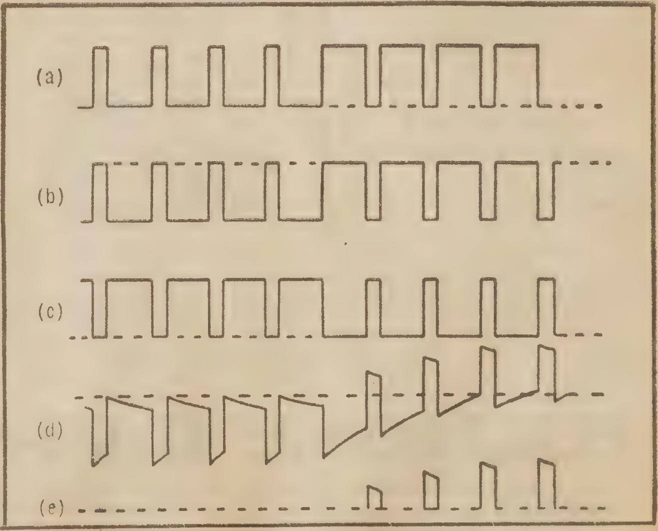

Figure 6. Illustrating the action of figure 5 in relation to the frame synchronising

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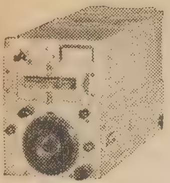

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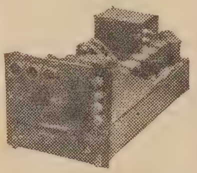

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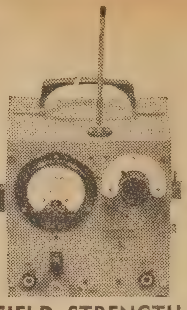

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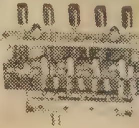

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In the first circuit, illustrated by figure 4, the output from the synch. separator is fed to separate differentiator and integrating circuits, similar to figure 3. They are then applied to the grids of separate valves and additional networks are provided in the respective plate circuits.

The pulses are consequently amplified and, by selecting the operating conditions to impose a limiting action on the part of the valves, the sides of the pulses can be steepened and the tops squared off. At the same time, the serrations on the framing pulse at the line frequency can be smoothed out, leading to a much more positive effect on the oscillator.

PHASE REVERSAL

Naturally, the introduction of an amplifying stage reverses the phase or sense of the pulses and this has to be taken into account in the overall design. In some cases it may be easy enough to reverse the phase of the input signal. In other cases it may be more convenient to provide an even number of amplifier stages and employ, at the same time, additional pulse-shaping circuits.

An alternative approach is represented by the circuit of figure 5, which extracts a rectangular framing pulse without the use of an integrator circuit, in the normal sense of the term.

The composite video input is fed to a pair of diodes employing a common cathode-bias circuit. The left-hand diode separates out all pulses and, by means of on ordinary differentiating circuit, produces the "spikes" necessary to trigger the line oscillator.

The right hand diode also separates out the timing pulses (5a) and couples them to the grid of an amplifier through a circuit having a long time constant. As a result, a d-c restoration effect goes on which virtually aligns the top of the pulses with earth potential (5b) and produces what are virtually negative-going pulses.

These are duly amplified and appear in the plate circuit (5c) but inverted in sense or phase. They are coupled through an R/C network to a further diode operating with a fixed positive bias on the cathode and providing a d-c effect.

TIME CONSTANT

The time constant of R3 and C3 is carefully selected so that the net result is as shown in figure 5d. During the line pulses, which by inversion are now longer than the frame pulses, the potential across R3 never reaches a point where current can flow through V3. However, when the pulse length changes, the period of discharge is longer than the period of charge and a current pulse flows through V3.

Properly arranged, the first of these rectangular pulses (5e) triggers the framing oscillator.

After all this, the reader will naturally be wondering how it is possible to create and control such an elaborate pattern of long and short pulses, merge them with the signal, establish blanking levels and all the rest. He can take comfort from the thought that such matters will not normally be his concern. Nor are they ever likely to be, unless he is engaged in the production of pulse generating circuits.

As far as the receiver is concerned, it is merely supplied with a train of pulses emitted by the station and following the standardised pattern.

Though some adjustment may be called for in individual receivers, many of the problems covering time constants and so on are worked out by those whose job it is to design individual circuits. Provided circuit values are adhered to and reasonable tolerances maintained in the components used, proper results will automatically be obtained.

The line and frame pulses, when applied to the local line and frame oscillators should lock them in automatically with the camera, the two oscillators beating out a perfectly regular pattern of triangular waves.

The timing pulses for the respective half-frames are arranged to occur alternately at the beginning and in the middle of the appropriate lines, so that the receiver automatically falls into step with the interlaced pattern.

OPERATION

When the set is first switched on, the line oscillator may operate in random fashion for a few cycles but it would soon be triggered into step.

Similarly, the frame oscillator may commence at a more or less random frequency, until it is suddenly triggered by a suitable pulse. This may happen to be the start of the interlace pattern, in which case the pulse would coincide with a half-line. At the same instant the transmitter would be preparing to send the intelligence belonging to the interlace pattern, so that the whole picture automatically falls into place.

The same thing happens when the receiver is tuned from one station to another or during a break in the transmission, when the station may switch from one set of pulse generators to another as might happen in switching to an outside broadcast. For a few cycles the receiver oscillators may lag but they are immediately picked up again when the new set of pulses occur.

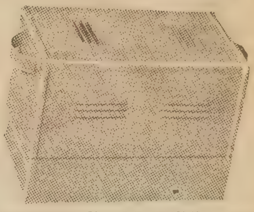
Should synchronisation be lost, for any reason, the picture may immediately vanish into a meaningless blur or, where the timing error is smaller, it may gradually "tear" apart into bands and segments.

So much for the synchronising pulses. It now remains to examine some of the circuits which are used to generate the basic line and frame sweep currents.

A SMALL bottle of methylated spirit is a handy addition to any radio work bench. It readily dissolves most forms of impregnating waxes, and is very useful for cleaning chassis, &c., which have become coated from an overheated transformer or choke. Applied with an old toothbrush, it may be used to remove surplus flux from valve sockets, switch wafers, &c., which may otherwise cause arcing.

N.H.V.
KITS

AMPLIFIER CABINETS



These streamlined amplifier foundation units consist of a standard chassis 3" deep with removable top in aluminium. Fitting over the top is a removable cover which has louvres on all sides and handles welded to the ends. Color Grey.

Catalogue No.	W	D	H	Prices plus Sales Tax
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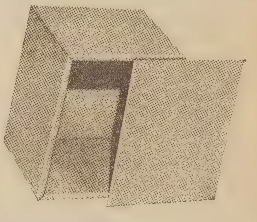
AC2	12	7	9	£1 12 6
AC3	17	7	9	£1 19 6
AC4	17	10	9	£2 15 0

Catalogue No.	W	D	H	Prices plus Sales Tax
AC SF 1059	10	5	7½	£1 12 6
AC SF 1279	12	7	9½	£1 15 6
AC SF 1779	17	7	9½	£2 6 6
AC SF 17109	17	10	9½	£2 19 6

Metal Utility Cabinets



This line of Cabinet is for housing electronic equipment of all types. It has a fixed back and removable front. Color Grey.

Catalogue No.	D	W	H	Prices plus Sales Tax
MC666	6	6	6	7/6
MC596	5	6	9	8/6
MC7810	7	8	10	12/6
MC6712	6	7	12	12/6
MC81010	8	10	10	15/6
MC81112	8	11	12	19/-
MC7915	7	9	15	19/-

Catalogue No.	D	W	H	Prices plus Sales Tax
MCSF776	7¼	7	6½	10/6
MCSF796	7¼	9	6½	12/6
MCSF7116	7¼	11	6½	14/6
MCSF8138	8½	13	8	17/6
MCSF101810	10½	18	10	28/6

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You Can Make Records at Home!

Microgroove recording has virtually revolutionised home recording on discs. It increases the playing time of records at least three times, without any drop in quality. Experience has shown that it is just as easy to record on microgroove as with the standard speed of 78 rpm.

LAST month we gave a general review of home recording as it stands at the present time, outlining the main points of consideration when using the equipment, together with some details of connecting the recorder to an ordinary radio receiver.

As pointed out in that article, while quite good results can be obtained with this type of approach, the aim of every home recordist should be to build a special job for the purpose which will allow records to be made from normal sources, providing at the same time quick playback facilities.

COMPLETE RECORDER

We have in mind the description of such a recorder which will record from radio, microphone, pick-up, or external source of signal (such as a short wave set) and which will also be a high quality radio set and gramophone amplifier.

This sounds a good deal to design into a single unit, but it can be done quite simply and at no more cost than for a six valve radio set, exclusive of the recording turntable and cutting head, of course.

Because the recording turntable is also an extremely high grade playback motor for records, this must be offset against the initial cost of the unit itself.

The FM receiver shown in last month's issue has now been converted in this manner, with all the necessary circuit changes catered for by two ordinary wafer switches — one to select the required input from the four channels mentioned above, and the other to change from record to playback.

TUNER

Our final design will substitute a tuner or the broadcast band for the FM tuner because, although the FM station provides the best source of radio programme quality, particularly on direct broadcasts, it is limited to one station only, whereas our final design must be capable of tuning in all the local broadcast programmes.

However, before we describe such a recording equipment — and it is scheduled for early release—there are quite a few matters yet to be discussed on recording generally.

The first and most important of these is the subject of microgroove recording.

Until recently, as every record enthusiast knows, records were made at either 78 or 33 rpm recording speeds with a standard grooving which allowed a maximum of 4-5 minutes on a 12 inch disc, and 3-4 minutes on a 10 inch disc for 78 rpm and correspondingly longer time for 33 rpm.

Unfortunately, the attractions of the 33 recordings were badly offset by the deterioration in high note response, particularly at the centre of the record, due to the lower velocity of the stylus cutting and playing back the records.

COST

As a result, the cost of recording was rather high. The cost of high quality recording blanks, although not excessive considering the difficulties of manufacture, ran into a tidy figure at the rate they were used on the popular speed of 78 rpm, a fact which was accentuated by the inevitability of spoiling a certain number while setting up and testing.

The use of 78 rpm meant also that the recording of material requiring a long period of continuous playing meant constant record changing, and excessive storage space for the discs themselves.

by

John Moyle

The position led to an investigation by the world's leading recordists of the whole position as affecting the selection of recording speeds and groove size.

The use of 78 rpm dates from the early days of records when both recording and playback were accomplished by the use of acoustic horns and diaphragms coupled to cutting and playback stylii which depended entirely on groove characteristics for a mechanical linkage to the recorded sound.

As a result grooves had to be big enough to handle considerable mechanical loading for playback by soundboxes of low compliance and considerable weight.

ELECTRIC METHOD

Electrical reproduction completely changed the whole position, particularly of recent years, when featherweight pick-ups were introduced which required only a few grams of keep the stylii in the groove, and in which high compliance was possible.

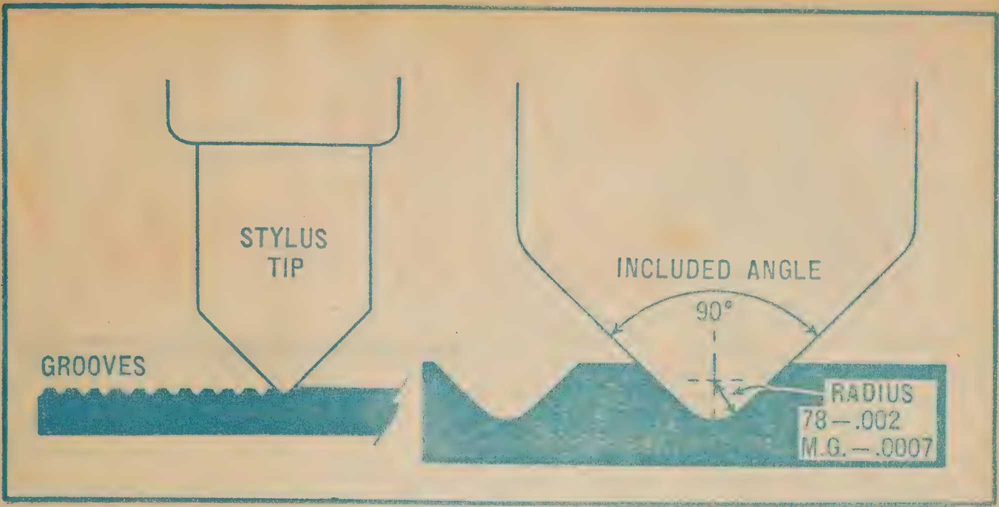
In other words, there is no longer a serious mechanical stress on the groove during playback, and a reduction in its size became not only practicable, but highly desirable.

The possibility of using finer and shallower grooves is, however, only half the problem. Without going too deeply into the mathematics of the matter, scaling down the groove width made possible the reduction of record speed without loss of quality. There is a definite relationship between the minimum curvature radius of the grooves traced out by the stylus during recording, and the effective radius of the stylus tip used for reproduction. It is possible, by a process of mathematics, to calculate quite accurately how closely to the record centre we can record at a given amplitude and groove width, to preserve a minimum standard of frequency response, and it was on this basis that recording engineers set out to establish new standards.

CLOSER GROOVES

The long playing feature is, of course, made possible because the finer grooves can be spaced much closer together, and played at a much slower speed.

This, briefly, is the background to the adoption of the development of the new microgroove standards. The speed has been dropped from 78 rpm



Left—Diagram showing general shape of cutting stylus—illustrating why the right depth of cut is important. Right—Enlarged diagram of stylus point giving essential measurements.

to 33 rpm, and the playback stylus tip reduced from about 3 mils to 1 mil (a mil equals one thousandth of an inch). The number of grooves per inch has been increased to 224 as normal, with an increase to 260 in cases where extra playing time is required.

The inner diameter of the recorded grooves is set as 5.5 inches, giving an effective stylus velocity of 9.6 inches per second. It is interesting to note that for a 4 inch inner diameter, a 78 record runs at 16.3 inches per second, but we must remember that the microgroove point has been reduced to approximately one-third of the 78, which actually puts us on the right side of the ledger.

DISTORTION

In fact, this overall gain is illustrated by other figures given by the originators of the long playing system. The LP record at the outside gives 85 times less distortion than the 78 records, and at the inside, after 21 minutes playing time, 6.2 times less distortion. These of course are theoretical figures, and do not allow for the inevitable qualifications imposed by processing methods. But they do illustrate the improvement which has been made by the adoption of new speed and groove standards.

The RCA system, which uses 45 rpm instead of 33, is even better in this regard, because while the groove dimensions are the same as for the LP records, the effective stylus velocity has been increased still further, with a consequent better distortion figure than shown by the 33 speed. Unfortunately, the higher speed cuts down playing time by about 50 per cent. If this reduction is acceptable, however, the higher speed would be prefered on this count.

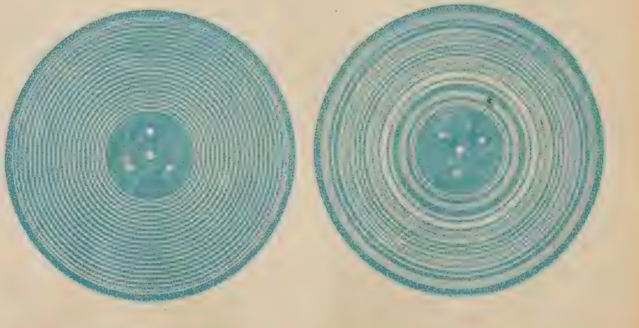
Now that microgroove equipment is available for use by the home recordist, he also can take advantage of all these things, which work out very much as one would expect from the figures we have quoted.

It must be admitted that we had mental reservations as to whether modest equipment would be good enough to accommodate the finer groove separation, and whether the extremely fine points of the cutting stylus — approximately .5 mil — would stand up to handling in the home. After some weeks intensive experiment, however, during which dozens of discs have been cut from almost every conceivable source, we are quite satisfied that it is no more difficult to make microgroove records at home than it is to record at 78 rpm. So much so that virtually all our recording activity now takes place with microgroove.

Careful comparison makes it clear that recorded quality is as good as if not better than with the 78 rpm. We have lost count of the number of discs cut with our original sapphire stylus, which seems now to cut records just as satisfactorily as it did at the beginning. A little more care is needed in handling, but this is no more than is reasonable. It really boils down to the habit of not taking anything for granted. But once the job is set up, and the right adjustment found for the correct depth of cut, it is only a matter of leaving well alone.

Noise level from acetate discs is very low in any case. With microgroove, it may be a little higher than with 78 at the centre of the record, but in practice, it doesn't amount to anything worth talking about.

The amount of modulation applied to the cutting head with microgroove is substantially less than with 78. This means that less audio power is required, and the recording armature has much less movement. Both these things help to reduce distortion, not only in the amplifier, but in the cutting head itself.



Left—Good equipment cuts evenly spaced grooves. Right—Badly adjusted or worn gears can cause irregular groove spacing or "grouping." No appreciable grouping is permissible with microgroove.

As a matter of comparison, the maximum deviation permissible for 78 at the inside groove for 100 per cent modulation is .002 inches, and for microgroove only .0009 inches. and for microgroove only .0009 inches.

This makes the task of watching recording levels a little more critical with microgroove, and as already pointed out, makes a level indicator almost a necessity. Fortunately this isn't hard to provide, and is really a requirement with any recording device.

SINGLE CHANGE

Reverting to the Byer recorder which we mention as being the only home recording unit widely obtainable, the change to microgroove merely consists in changing from one turntable spindle and wormgear to another having a worm which gives the required higher pitch for the closer grooves. Only sapphire cutting stylii are practicable for microgroove and these, although more expensive, have a very long life.

As mentioned last month, we have made a number of recordings at 45 rpm by using a spindle pulley smaller than that provided for 78. A comparison with records made from the same source at 33 rpm reveals that the difference in high note response is quite noticeable, particularly at the outside of the records. The shorter playing time, however, does limit the use of this speed.

Troubles with bad cutting are varied in nature. Rumble evidenced by a deep hum which comes and goes, sometimes building up sufficiently to cross cut grooves, is nearly always due to bad mounting of the unit.

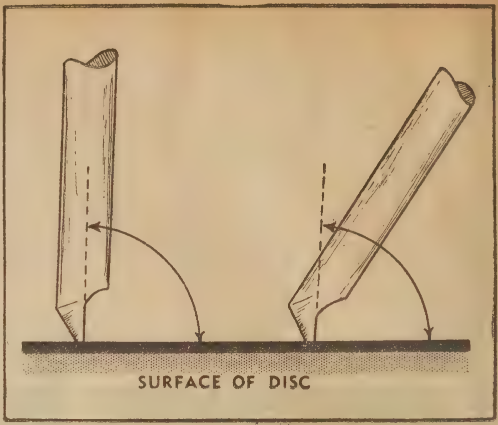
The turntable motor is invariably spring or rubber-mounted to absorb what small vibration there is with a good motor. If this is to be effective, the unit housing must be firmly screwed down to a firm base. If it isn't, it may pick up vibrations from the motor and render the spring mounting largely ineffective. See that the board or case in which the unit is mounted is strong and heavy, and that it allows the housing to be screwed down without any signs of stress or warp.

OTHER FAULTS

Motor rumble appears on the disc as spiralling patterns which appear to move across the record as it is played. Often they appear near the centre, disappear, and return again before the cut is finished. They are easily recognised and heard.

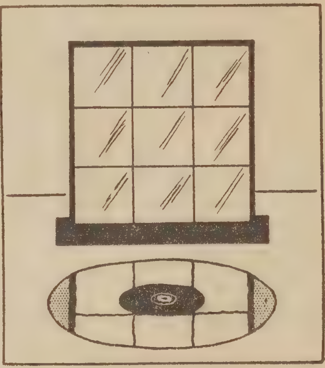
Another fault is known as "grouping," or uneven spacing between grooves. If this is bad, it means that the spacing will in spots become so close that one groove will cut into the next. It is particularly serious when recording microgroove.

Bad alignment or fitting of the gear assembly is nearly always the cause. In the Byer equipment, the worm and quadrant assembly is lined up at the factory, and should not be altered unless you are sure of your ground. The worm on the spindle should not bind at any spots while driving the gear on the small shaft, which in turn drives the quadrant. Play in the needle bearings of this shaft may allow quadrant pressure to cause binding at certain positions. You should be able to spin the spindle when the quadrant is engaged, if not freely, at least smoothly at all times.

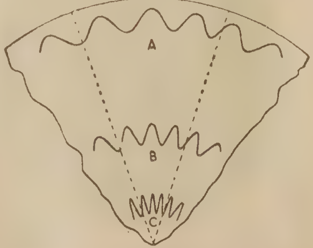


It is important that the cutting stylus should make an angle of 90 degrees with the surface of the disc.

Adjustment of the needle bearings to eliminate end play, and of the quadrant so that, when engaged, it just rises against its worm drive by the merest fraction of an inch, we have found the best setting. But do not interfere with the adjustment unless you are sure it is necessary. If you get boxed up with the adjustment, a trip back to the factory is about the only cure unless you are very clever.



A good, flat disc should reflect a near perfect image of straight lines as provided for instance by a window.



Showing how the groove modulation pattern "closes in" towards the centre of the record.

A test for grouping is to play a plain, unmodulated cut. A good recorder will show no more grouping than can be detected as a faint "shadow" appearing at regular intervals of about half a dozen grooves. If you can detect a definite change in spacing with the glass, or hear any clicking or bumping noises accompanied by grouping, some adjustment is indicated.

Proper lubrication is also important for smooth running. Dirt in the spindle socket, or even too much and too heavy oil, might upset alignment. A little fine machine oil or graphite is OK here, and a little Shell Mytilus A on the worm gears should keep them running smoothly.

DISCS

Practically all the recording blanks available now are of good quality and can be relied on to cut good records. Some are a little harder than others, but so far we've found little difference otherwise. Most of them are pretty well inert—their characteristics do not alter substantially after they are manufactured. Today's discs rarely "harden" once the initial excess solvent has dried from the lacquer. Such processes are carefully watched in the factory and there is little point in attempting to treat a record after cutting.

So-called "hardening" fluids may have had an application at one time, but today they are little more than lubricating wax in solution. With a modern lightweight playback pickup, there is no need for them.

The main disadvantage of acetate discs is that they scratch very easily. Don't allow anything to touch the surface before or after cutting if it can be avoided. Don't slide them in and out of their paper covers—lift them out with the sides of the covers bulged away from the surface. Handle only by the edges, and keep them where dust cannot reach them. Don't leave them lying round without covers. Once they collect scratches, surface noises will develop, and the silky smooth background will be gone for ever.

It's hard to estimate playing time, but this should be quite substantial with a lightweight pick-up. The reason we have mentioned the Acos GP20 more particularly is that it is very light on records. This doesn't mean that other lightweight pick-ups can't be used quite well, of course.

Sapphire playback stylii are really the only thing worth considering these days. On the whole, steel needles are not suitable for acetate records. They are generally too sharp and, because there is no abrasive in the discs, don't grind themselves in as they do on shellac discs. The sapphire has an accurately ground, smooth point, and is better in every way.

SAPPHIRE BEST

Sapphire cutting stylii are also superior to the steel for several reasons. Steel do not last nearly as long, although they will cut quite a few records without deterioration. Their life is hard to estimate, as corrosion is a big factor. They are sharper than sapphire, and are generally ground with straight sides. They can be expected to cut more records cleanly at one "sitting" than over a period. They should always be left idle with a dab of vaseline or oil on the tip to reduce corrosion.

Steel stylii are made in both straight and bent shank, but in each case, the tip is shaped so that it sits vertically on the disc. This is most important for correct cutting. Owing to the nature of the Byer head, sapphire stylii are always made with bent shanks to give the correct angle.

A good test for vertical cut is to observe the reflection of the stylii when resting on a blank disc. If there is any departure from the vertical, the image will accentuate it. A line drawn through the plane of the cutting edge should also run through a line drawn through the image of the edge, in an imaginary continuation of it.

THE SWATHE

A good stylus, when placed on a revolving record, should immediately throw the fine thread or swathe clear of the point toward the centre of the record. The swathe should then coil up neatly as the record is cut. It should be bright and sharp in texture, as should also be the groove itself. A broken tip will generally cut a grey-looking groove which has no clean, sharp bottom to it. Actually, the groove bottom isn't a true V, but is rounded according to the shape of the tip. A good glass, magnifying about 10 times, should reveal this shape quite well when viewed in the right light.

If the swathe persistently falls to the outside of the stylus, good cuts are impossible, as sooner or later, it will pile up round the point, and you will have to start again. Such a fault is nearly always due to the stylus not being squarely mounted in the chuck, not having a vertical angle, or being worn. The stylus is generally mounted so as to be very slightly ahead of a tangent but you will rarely have to worry about this point unless using a head you have fitted yourself.

Sometimes the stylus will "whistle" as it cuts a groove. This is a rather baffling fault, but it rarely appears with a well-ground stylus, with one correctly mounted, or with a new one.

A sapphire stylus isn't generally as sharp as a steel cutter, as, although it can be more smoothly ground, it won't take such a sharp point. However, it normally is ground with burnishing facets, which give a smooth groove, and which help to cut a well-thrown swathe.

Great care should be taken to avoid cutting through to the aluminium base. This may chip the point, or weld small beads of metal to it, which cut a rough groove. Always adjust the depth by cutting a few light grooves, and gradually increase the pressue until the right groove separation is obtained. Ideally this will be 60-40 groove to land ratio, and for microgoove just a little deeper to about 70-30. This ratio isn't always easy to observe so watch the light angle when you are looking for it.

MODULATION

A sure sign of over modulation is the appearance of intergroove modulation. If a loud passage can be heard as an "echo" in the next groove you have too much volume into the head, and even if you can't hear the echo through loud music, it will nevertheless be there to cause distortion. Fortunately, the quiet surface allows you to cut at reasonable level without worrying too much about surface noise, and careful observation of the grooves will show whether you are cutting them dangerously close to each other under modulation.

Only experience can tell you how to judge your levels best. After a while you get to know what types of music or performances are likely to produce sudden peaks which must be watched, and which are smoother and less likely to vary suddenly in their output. Direct recording with your microphone is perhaps the hardest to handle, as someone is almost certain to talk too closely and ruin your cut. These are some reasons why that level indicator is so valuable.

The first public television demonstration took place at London's Science Museum in September, 1936. In November that year a regular television service was inaugurated at the Alexandra Palace, after £5,000,000 had been spent on research. It cost the BBC £500,000 to launch the service.

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HOW TO BUILD A RADIO RECEIVER

There is more to making a radio receiver than simply bundling a collection of components into a chassis to conform with a circuit diagram. Some of our more advanced readers become a little impatient when we repeat elementary points on set wiring in constructional articles but it is necessary because time after time we come across examples of sets wired so that they look like the proverbial rat's nest!

THIS was brought forcibly to our minds in connection with a school which holds regular evening hobby classes in a number of subjects, including radio. Those interested bring along their efforts at set building for comment and assistance in solving particular problems.

None of the members had actually built a set before. Very wisely, it had been decided that everyone should build a simple crystal set first and then try various circuits, coils, crystals, headphones, aerials, &c, in order to gain a background of knowledge to help with more advanced set building.

THE PORTABLE

Everybody agreed except one man who was rather keen to build a five-valve portable. As a matter of fact, he finally decided on the Universal Portable described in the January, 1949 issue of Radio and Hobbies.

Readers will remember that no wiring diagram was prepared for this set as we took the view that it would be too advanced anyway for a builder who had not reached the stage where he could read circuit diagrams confidently.

Despite our warnings about the troubles likely to be encountered by an unpractised hand working around miniature sockets in a crowded chassis, our friend decided to go ahead with the project.

The result was that he turned up with a classical "rat's nest" version of the Universal Portable almost complete.

WIRING!

So long is it since we have seen a beginner's version of one of our sets that we did not realise that it was possible to build up a set to correctly follow the circuit and yet make so many departures from accepted practice. The fine solder joints were reasonably neat but it was so obviously hopeless that we did not even bother to switch the set on.

We feel sure that our friend will not mind if others benefit by his mistakes and we therefore decided to write this article.

The most obvious "blue" concerned the leads to the tuning gang. Apparently, he had bolted the gang in place (and not too firmly either!) before soldering the leads to the stator plates. The leads had been soldered to the top lugs of the gang and bent down in a graceful arc fully two or three inches longer than they need have been.

In the case of a portable set which is to be subjected to a fair amount of bumping around in its existence, it is essential that all components connected with the tuning system be mounted as firmly as possible, otherwise the tuning will vary when the set is moved, making it impossible to keep it in calibration with the dial markings and, further, making it quite impossible to keep the three tunable circuits in correct alignment with each other.

Apart from this, the three leads ambling down alongside the gang have sufficient magnetic and capacitive coupling between them to cause trouble with oscillation since adjacent leads are input and output circuits of the RF amplifier valve.

Tuning gangs are usually provided with a set of solder connections both underneath and on top of the stator plates and the normal procedure is to solder lengths of hook-up wire to the underneath connections before mounting the gang. Holes are always provided in the chassis so that the leads can be brought straight through and in most cases will be of the order of ½" long.

TRIMMERS

In the case of a broadcast band receiver, it is convenient to attach the trimmer condensers to the top set of solder connections where they are both firm and easily accessible.

The aim is to make every component in the set easily accessible and above all firm so that normal bumping and vibration will not cause them to be displaced. This applies particularly to the tuning gang, trimmers, coils and all small components associated with the tuned circuits.

In order that all small components can be mounted firmly, each solder joint should be made at some firm anchor point such as a valve socket, coil or switch terminal or, if a junction of several small components occurs at a point where this is not possible, install an insulated tag strip or a threaded ebonite pillar with a solder lug screwed to the top. By the way, with the latter make certain that the screws are not long enough to touch in the centre and cause a short circuit.

Our friend had apparently never heard of either tag strips or ebonite pillars because there were numerous joints made in mid air and heavy components such as the electrolytic high tension bypass condenser virtually supported only by a single lead.

This is bad enough in itself, but the position was worsened by the fact that none of the leads had been cut but had rather been left at their original factory length. To the eye of a practised radio technician the overall effect was somewhat reminiscent of an obese gentleman in need of an artificial support.

This is bad enough but our friend had not used insulated tubing to cover the ends of small components and it is almost certain that some of the wires would touch and cause a short circuit if the set were switched on. In the battery set, and more especially a battery set with a series filament network as in this case, a short between the high tension line and part of the filament line could easily ruin the filaments of several valves.

LONG LEADS

Next on the list of unforgivable sins we noted the way connections between plate pins and coils were made and grid pins and coils. In most cases these leads need be no longer than about ½" but we were confronted with loops of wire involving 3 or 4 inches. We admit that the extra inductance introduced by the wire is not of any great consequence, especially at the I.F., but the additional capacitive coupling between the inputs and outputs of successive stages would certainly cause them to oscillate when the tuned circuits are aligned for maximum gain.

This brings up another point which applies particularly to miniature valves and sockets. Metal spigots, about 3/16" in diam. are invariably placed in the centre of the socket. It is essential that these spigots be securely earthed, otherwise capacitive coupling will cause oscillation in just the same way as the long input and output leads.

The importance of earthing the spigots had been explained previously and we thought it impossible for there to be any misunderstanding. The spigots were certainly earthed in accordance with instructions but the earthing was carried out with lengths of hook-up wire anything up to 6" long.

TESTING!

Our victim, by this time a little disheartened, protested that he had carefully tested each connection with a battery and torch globe!

Normal practice is to bolt a solder lug close to the socket and run a length of tinned copper wire as direct as possible from the lug to the spigot. If one of the socket connections is earthed, you can easily pick up this connection with the same length of hook-up wire, but be very careful about earthing unused socket pins or using them for tie points because, in the case of miniature valves, such pins are frequently used to support the internal structure of the valve.

Returning to the earthing system, if you are using a sprayed steel chassis, solder lugs mounted under bolts cannot be depended upon to provide low resistance and noise free return points. To make sure that everything is securely earthed, it is very desirable to run a length of tinned copper wire around the chassis to link up all the earth points so that even if the chassis were made of cardboard, the set would still be capable of working.

We had warned him previously about the need for good solder joints, and, in all fairness, must admit that the majority of his joints were quite neat and satisfactory, except for the fact that many of them were in mid-air.

One fault was the stripping of too much insulation from the hook-up wire so that a length of bare wire was present with attendant possibilities of shorts. In the case of ordinary plastic hook-up wire, it is usually only necessary to strip off about 1/8" of insulation as the heat of the soldering iron will cause it to shrink back about another 1/16".

Due to a previous warning all sockets and coils had been correctly orientated in the portable but an error frequently made by beginners is to install sockets, coils, &c. indiscriminately, and then to run wires to make the various connections. As a result, many wires are frequently a good deal longer than they need be.

This is of little importance where a small TRF is concerned, but it can be disastrous in the case of a modern, high-gain superhet.

All external connections to any radio should be made with the utmost care since it is very likely that the set will be taken out of its case a number of times during its normal life for normal routine service, replacement of small components, valves, batteries, &c.

For the "Universal Portable" we have suggested a plug for the battery connections, since it avoids the need for sorting out connections and the possibility of making mistakes.

LOOP CONNECTIONS

The connections for the loop aerial between the hinges and the case will probably be removed several times during the life of the set, and it may be worthwhile to install a couple of terminals or a tag strip. In the case of terminals, make sure that they are firm.

Unfortunately, there was an error in the published circuit of the "Universal Portable." The B plus connection of the second IF transformer was simply bypassed to earth with a .1 mfd condenser rather than connected to the bypassed high tension line. Our draughtsman inadvertently placed a crossover loop where a connection should have been shown.

To anyone who had had any previous experience with set building, the error would have been obvious and only a beginner, such as our friend, would faithfully follow the circuit.

Apart from complications arising from involved wiring, this is a very good argument against beginners tackling the larger sets. While each circuit we publish is carefully checked by several members of the technical staff, it is always possible for an error to slip through.

In the case of small circuits, which we publish in conjunction with wiring diagrams, the chances of an error are very much less because there is less to go wrong and the circuit can always be checked with the wiring diagram.

As we have already explained, we prepare wiring diagrams for some of our smaller sets. These diagrams are intended to help those who are not too confident of their ability to read a schematic circuit, but they certainly do not take the place of a circuit. The general idea is to use the two in conjunction.

Most experienced constructors would very much prefer to work from the circuit rather than the wiring diagram. Actually, wiring diagrams are frequently used in factories, but this is to ensure uniform interpretation of the circuit and assist in cases where relatively unskilled people are used for the work.

(Continued on Page 95)

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In addition to the popular Connoisseur products listed below, new pick-ups and turntables specially designed for use with the latest micro-groove long-playing records are on the way.
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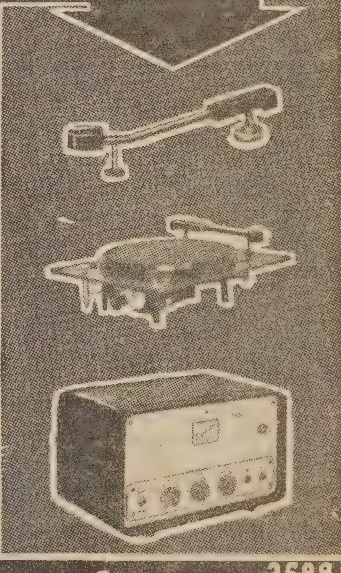

ELEMENTS OF PULSE MODULATION

To many enthusiasts "pulse modulation" is a new and rather mysterious term. While it has no place, as yet, in ordinary broadcasting, pulse modulation is being applied rapidly to communication work. This excellent paper from the Aerovox Corporation explains the elements of the system for those who want to know "how it works."

THE use of pulses, or short bursts of radio-frequency energy, is well-known in connection with the transmission of television synchronising signals, and in radar practice. Pulse signals of this type have also been applied to microwave radio-relay systems, resulting in the revolutionary new techniques of voice communication known as "pulse modulation."

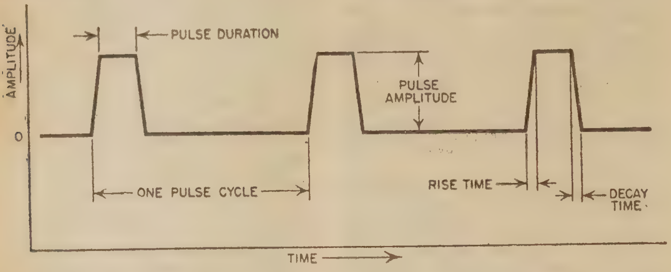

Fig. 1—Diagram showing the essential features of pulse definition.

Cross - country, point-to-point radio-relay circuits utilising these techniques have many practical advantages, and are rapidly replacing older types of wire, cable, and relay-link equipment in both commercial and military applications.

ADVANTAGES

The advantages of pulse modulation include economy of equipment, size and weight, good speech quality, adaptability to multiplex operations with low inter-channel cross-talk, enhanced signal-to-noise ratios, and ideal utilisation of the special microwave tubes such as the magnetron and bylstron.

Microwave frequencies are used in most radio-relay systems employing pulse modulation since relatively wide bandwidths are required, and because the shorter wavelengths permit the greater antenna directivity required to maintain privacy in point-to-point radio telephony.

There are four general kinds of pulse modulation:

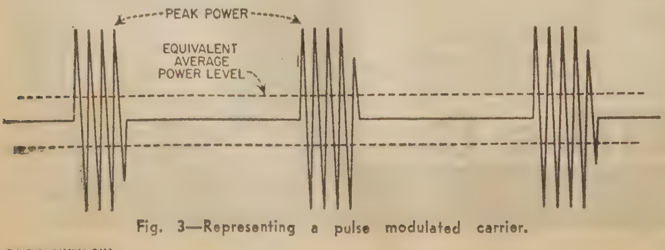

Fig. 3—Representing a pulse modulated carrier.

Pulse Amplitude Modulation (PAM)
Pulse Time Modulation (PTM)
Pulse Code Modulation (PCM)
Composite Pulse Modulation (CPM)

In addition to these basic types, there are over forty methods of pulse modulation using combinations of the above types impressed as pulsed sub-carriers on either amplitude modulated or frequency modulated r.f. carriers.

Since most of these systems are highly complex, and, in some cases quite impractical, the purpose of this paper will be more aptly served by confining this discussion to the more basic types of pulse modulation.

A pulse may be defined as a single electrical disturbance of short duration. As used in radar, television, and communications, pulses, usually have rectangular or trapezoidal wave-forms. Such wave-forms represent the abrupt rise of a d.c. voltage from zero to a constant value, the maintenance of that value for a short period of time, and an abrupt decrease to zero again.

A recurrent series of such pulses, and the standard terms used to define pulse characteristics, are shown in Fig 1. The frequency of occurrence of the pulses is called the pulse repetition frequency and is commonly abbreviated PRF.

DUTY CYCLE

The duration of the pulses employed in pulse modulation is usually measured in microseconds. The product of the pulse duration is seconds, and the pulse repetition rate in pulses-per-second is called the "duty factor" or "duty cycle." It represents the ratio of the time that a pulse is present to the time of one complete pulse cycle.

As an example, if the pulse duration is one microsecond (.000001 second) and the PRF is 10,000 p.p.s., the duty cycle is .01, or 1/100th. This means that the pulse occupies only 1/100th of the period of one pulse cycle. In other words, there are 99 microseconds between each one-microsecond pulse.

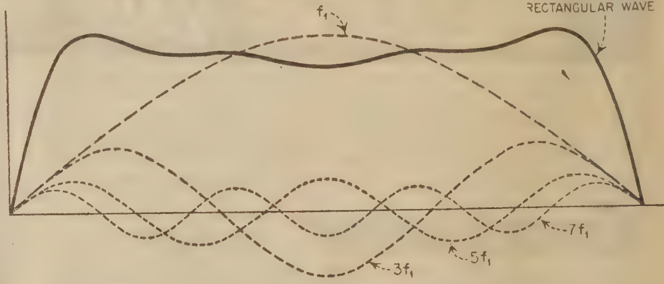

Fig. 2—How the presence of odd harmonics build up [illegible] square wave.

Although the pulse repetition frequencies employed in pulse modulation are usually less than 100 kilocycles, frequency components much higher than this are required to form essentially rectangular pulses.

In other words, if the pulse is broken down into its sine wave components, it is found to consist of a Fourier series made up of a fundamental, and its odd harmonicse, as depicted in Fig. 2.

The steepness of the sides of the

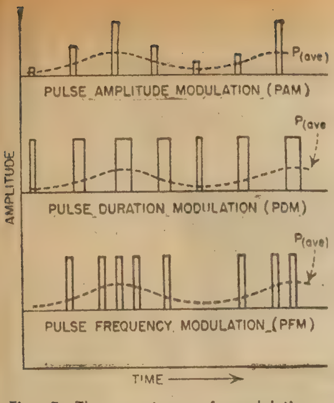

Fig. 5—Three systems of modulation.

pulse determines the number of harmonic frequencies required to form it.

Theoretically, if the pulse were perfectly rectangular, it would contain an infinite number of sine wave harmonic components. Under these conditions, an infinitely wide band of frequencies would be required to transmit it without distortion.

In practice, frequencies up to several megacycles are usually present, necessitating the use of video frequency circuits for the handling of pulses. The actual video bandwidth required depends on the rise or decay time of the pulse in accordance with the approximate relationship:

(1)

$$F = \frac{1}{2t_r} \text{ megacycles}$$

Where: F is the required video bandwidth.
t_r is the pulse rise or decay time, whichever is shorter. (Microseconds)

Thus, a pulse having a rise time of 0.2 microseconds would require a video bandwidth of 2.5 megacycles for undistorted transmission.

When pulses of this type are used to modulate an RF carrier, the result is a train of RF pulses like those of fig 3, having wave envelopes essentially like those of the modulating video pulses.

The RF band-width required to faithfully transmit the pulses is twice as large as the video band-width given in Eq. 1, however, since an amplitude modulated carrier has sidebands on either side, which are removed in frequency by the amount of the highest frequency components present.

ENERGY DISTRIBUTION

The distribution of transmitted energy within this band-width would be approximately as shown fig. 4, which is the RF spectrum of a typical pulsed carrier. For extremely short pulses having very fast rise times, the RF band-width may be many megacycles. For this reason, pulse-modulated systems usually require considerably greater band-widths than are needed for other communication systems having equal rates of intelligence transmission.

When a transmitter is pulse-modulated, it is possible to obtain instantaneous RF power outputs which are very high compared to the continuous-wave power obtainable from the same transmitter.

These high "peak" powers are achieved because it is possible to apply very high voltages to the transmitting tubes and to allow them to draw very high anode currents during the short pulses without exceeding the average power dissipation ratings of the tubes.

(2)

$$\text{Average Power } (P_{ave}) = \text{Peak Power} \times \text{Pulse Duration} \times \text{PRF}$$
$$= \text{Peak Power} \times \text{Duty Cycle}$$

Thus, tubes rated for a few watts average power output when operated c-w may be capable of delivering kilowatts of instantaneous or peak power when pulsed. The average power contained in a pulse train is related to the peak power by the duty cycle in the following manner.

In the RF pulse train of fig. 3, the average power level is shown by the dotted lines. It represents the power level which would be present if the pulse peaks were smoothed out to form a continuous signal containing equal average energy.

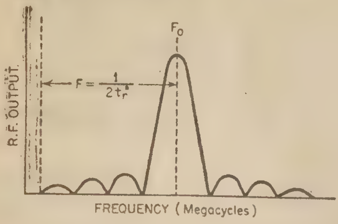

Fig. 4—Spectrum of pulse transmitter.

Most of the simple systems of pulse communication function by causing the average power of the pulse train to vary in accordance with the modulating signal. As shown by Eq. 2, this may be accomplished by varying either the peak power, the pulse duration, or the pulse repetition frequency.

These systems are classified as pulse amplitude modulation (PAM), pulse duration modulation (PDM), and pulse frequency modulation (PFM), respectively.

Figure 5 illustrates how pulse sequences of these three types would appear when modulated by a sine-wave signal. The dotted lines represent the average power variations of the pulse train. This is the wave which is reproduced in the receiver when the pulse carrier is demodulated.

The process whereby the characteristics of the pulse train are modulated by the instantaneous value of the modulating signal is known as "sampling." In other words, the modulating wave is sampled at intervals determined by the PRF.

To reproduce the modulating wave without appreciable distortion, the sampling frequency must be 2.5 or 3 times higher than the highest modulating frequency. Thus, to effectively reproduce voice frequencies up to 3000cps, a sampling PRF of about 9000 pps would be required.

Another form of pulse modulation which has been used to some extent is called pulse position modulation, abbreviated PPM. In this system, the transmitter pulse duration and amplitude are held constant, and the average repetition rate and average power nearly so. Modulation is accomplished by varying the time interval between successive pairs of pulses.

These varying intervals are then converted to pulse duration modulation at the receiver by a "flip-flop" multivibrator. The first pulse of each pair triggers the multivibrator to start a locally-generated pulse, which continues until the second pulse arrives to turn the circuit off.

MULTIPLEXING

Multiplexing is the technique of impressing two or more communications channels on a single circuit so that each can be operated simultaneously without interference with the others. This may be done by separating the individual channels on either a frequency or a time basis.

Pulse modulation is particularly adaptable to time-division multiplexing because of the long intervals between pulses during which no signal is being transmitted. This makes it possible to send other pulse signals during these intervals which may be separated at the receiver by their time of occurrence.

The basic principle of time-division multiplexing is illustrated in the hypothetical telephone circuit

(Continued on Page 86)

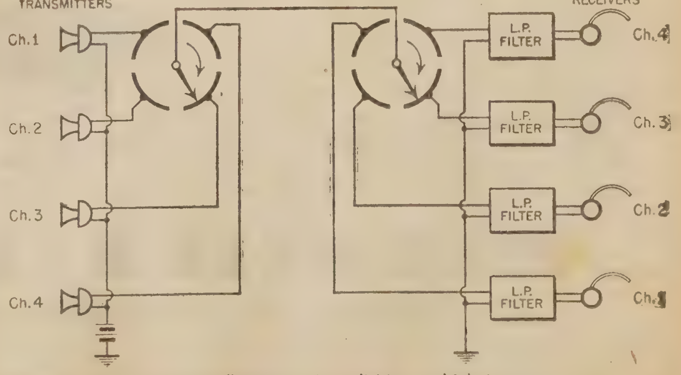

Fig. 6—Illustrating time division multiplexing.

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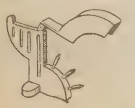

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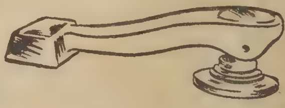

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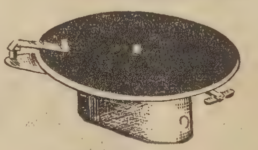

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Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A SIMPLE VALVE TESTER

Without a doubt, there have been many experimenters who have wanted to test a valve "on the spot" but have not had the necessary equipment on hand nor the wherewithal to make that possible. Here is a simple design submitted by New South Wales reader which may appeal both to yourself and to your pocket.

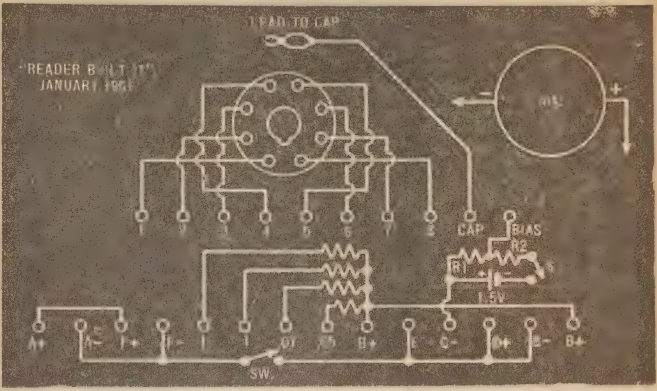


Fig. 2. This is the basic circuit showing the wiring of one socket only.

OUR contributor is Mr. C. Gates, of "Ubinia," Balladoran, 4W, NSW, who states that he has been using this tester for some time and has found it quite useful, both for work, at home, and for outside servicing.

The tester functions on the "grid-shift" mutual conductance principle. To illustrate the basic operation, Fig. 1 shows a pentode with normal voltages applied to the electrodes with the exception of the control grid, where the bias is 0.5 volt below the normal. The screen is fed through resistor R to drop the full B plus to the required level.

With switch S open, the meter will show a steady value of plate current. By closing switch S, the bias is increased by a portion of the cell voltage and the meter reading will fall by an amount depending mainly upon the mutual conductance of the valve. With a new valve, this lower reading will form a reference figure for that particular type. It will be necessary to make up a chart or table to show this reading, together with the setting-up data for the valve types in which you are interested.

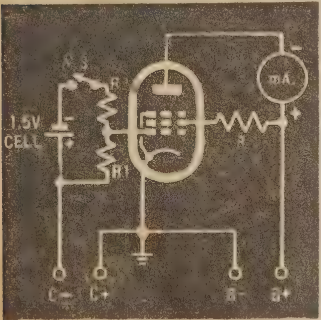


Fig. 1. This diagram illustrates the principle of operation.

In the contributor's instrument, R1 is 1000 ohms and R2 is 500 ohms, a combination forming a voltage divider which picks off 1 volt of a 1.5 volt cell. The swinging of the bias from 0.5 volt below normal to 0.5 volt above by the 1 volt picked off from the cell ensures that the test is made over the linear portion of the valve curve.

Do not be too perturbed if the application of the definition of Gm, that is, mutual conductance, does not produce the same figure as that given in the valve data sheets. By the way, Gm is the rate of change of plate current in mA with change of grid voltage, all other electrode voltages remaining constant.

VOLTAGE VARIATION

Apart from other reasons, series resistors in the screen feed and variation in power supply voltage with variation in load will somewhat modify the actual Gm figure. This can be overcome by making complicated additions to the design, but the added effort is not necessary when all that is required is a meter reference reading for a given set of conditions.

Fig. 2 shows the basic circuit of the tester with only one socket. Other sockets can be added by wiring the appropriate pins to the pin jacks. As you can see, it is simply a matter of wiring socket pins to one row of pin jacks and a selection of electrode operating voltages to another row. Connection from one row to the other is made with short patching cords with a banana plug at each end.

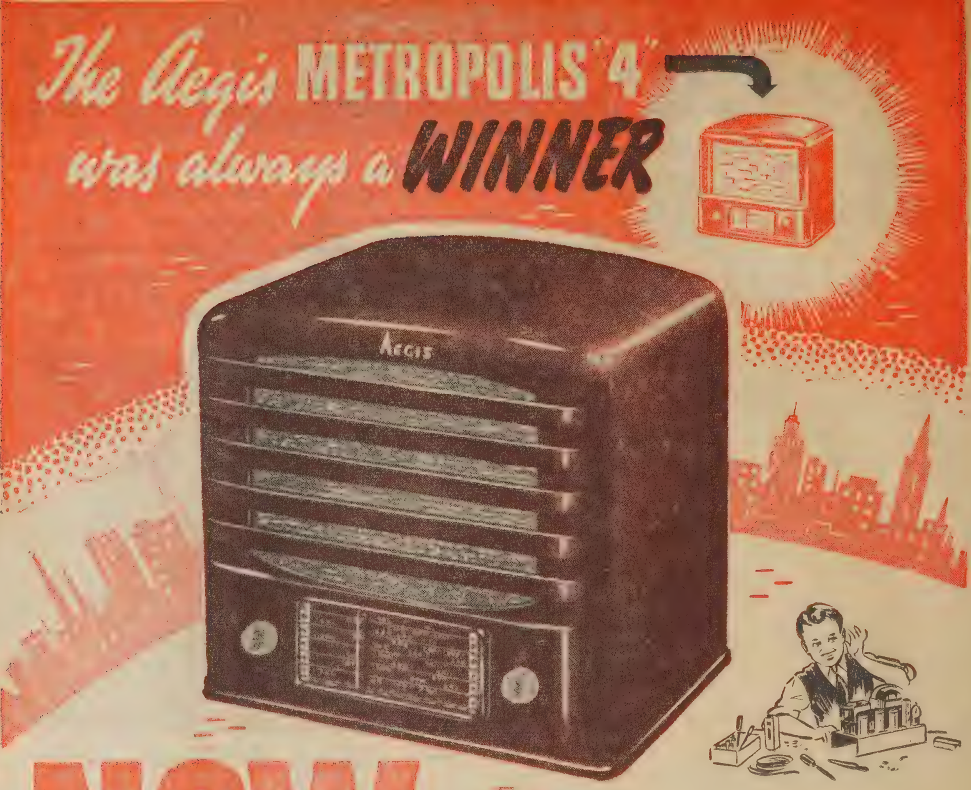
The four screen feed resistors wired to the lower row of jacks are of values which suit the requirements of the contributor. You may find need to vary them or even add others. The switch SW is closed for battery valve test and opened for testing heater type valves, the idea being to isolate the heater from the cathode in the latter case.

METER

The meter can conveniently be the usual multimeter set to read on an appropriate range of mA. Switch S should be a push-button type to avoid leaving the resistors across the cell when not in use.

Our contributor used an external battery supply. If an internal supply is arranged, whether battery or a-c, several of the pin jacks in the lower row can be dispensed with. To obtain a reference reading for a valve type, full operating voltage on electrodes other than the filament or heater is not necessary, although one should strive to check a valve over a linear portion of its characteristic curve. Such curves are given in valve data sheets.

The unit could be mounted in a carrying case along with other items of test equipment, a common power supply feeding the entire group.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TRADE REVIEWS AND RELEASES

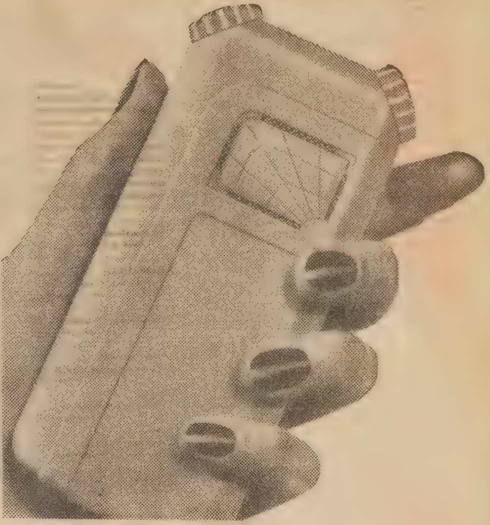
PALEC MAKES HEARING AID

Of particular interest to persons inflicted with partial deafness is the news that an Australian manufacturer is placing on the market a hearing aid unit which is considered comparable in every detail with units manufactured overseas.

CALLED the "Palec," this hearing aid is made in Australia by Paton Electrical Pty. Ltd., of Ashfield, NSW, well known for their wide range of electrical instruments and electronic equipment.

A considerable amount of careful design has gone into this unit, covering points ranging from the reduction of frictional noise on the microphone unit to the limiting of the battery drain. Miniature construction and resulting lightweight renders this aid ideally suitable for carrying in the pocket or in a handbag. Its versatility is further increased by the handy clip fitted to the back of the case.

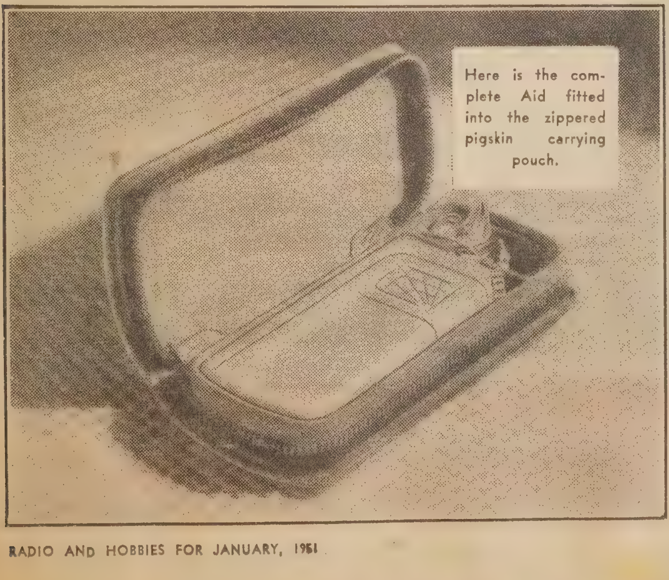
The microphone unit is quite sensitive and combined with the three stages of amplification produces more than sufficient overall gain for average use. The microphone unit itself is set behind a recessed baffle which replaces the conventional grill and thus effectively reduces frictional noise and tends to cushion the unit against vibration.



This general view of the Hearing Aid gives an idea of the size of the unit and appearance of the plastic case. The miniature microphone is set on a recessed baffle behind the decorative grill.

Two controls are fitted in an unobtrusive manner at the corners of the top of the case. One is for volume and the other is a combined battery switch and tone control. Apart from the "Off" position of the control, there are three positions of treble attenuation providing the user with a means of reducing the severity of annoying background noises.

The ear-plug receiver is of the miniature magnetic type and is connected to the unit by a lightweight flesh-colored plastic-covered cord. A miniature plug is fitted to the cord to permit the removal of the receiver from the aid.



Here is the complete Aid fitted into the zippered pigskin carrying pouch.

The entire unit is housed in a moulded plastic case with smooth contours and which is available in a choice of two colors, ivory or black. The microphone and amplifier assembly is located in its own sealed compartment in the top half of the case to avoid the ingress of dust and the possibility of damage to the miniature components or wiring during battery replacement. Portion of the lower half of the case can be quickly and easily removed to allow access to the batteries which are held in place by special contact clips.

The actual size of the case can be gauged from the dimensions which are 5in by 2 3-8 by ¾in. The complete hearing aid including batteries weighs 6½ ounces. An attractive pigskin carrying pouch is available at extra cost.

The batteries used are of the type manufactured in Australia especially for hearing aids. Low running costs are claimed. The A battery supplies 1.5 volts and has a drain of 50 mA. The B battery provides 30 volts of high tension and has a drain of 0.5 mA.

Other technical specifications given by the manufacturers quote the power gain as 130 db and a frequency range of 300 to 5000 cycles.

It is proposed to market the aid through radio dealers throughout the city, suburban and country centres. Dealers interested in handling the Palec Hearing Aid should apply for details to Paton Electrical Pty. Ltd., 90-94 Victoria Street, Ashfield, Sydney, NSW.

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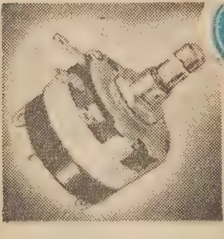

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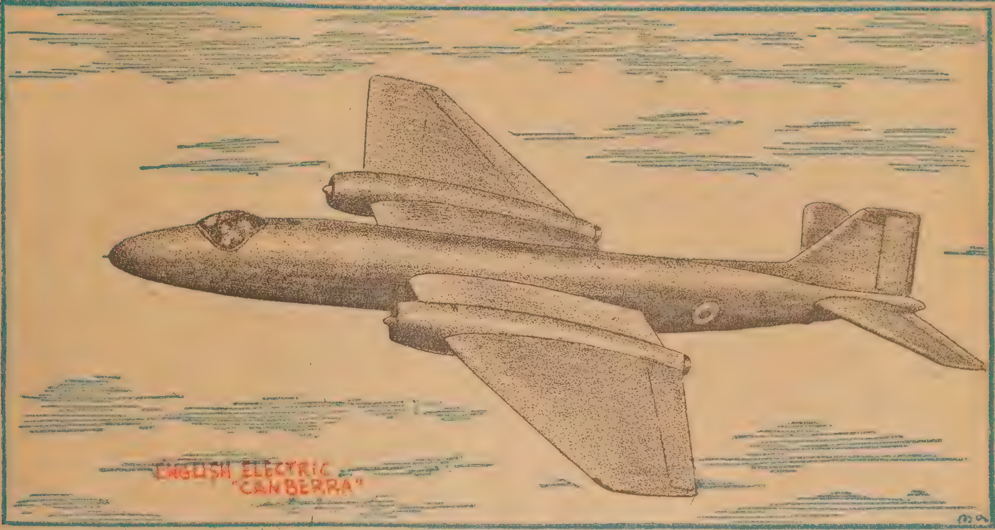


Sleek and powerful, the English Electric A-1 "Canberra" is a twin-jet medium-range bomber of unusual interest. So promising is its performance that it has been chosen by the Royal Australian Air Force for production in Australia.

DESIGNED for high-altitude operation, the Canberra is of conventional mid-wing monoplane layout, featuring all-metal construction.

Mounted in nacelles at the extremities of the centre section of the wings are two Rolls Royce Avon axial-flow turbojet engines.

The Canberra has tricycle-type landing gear, fully retracting. Main dimensions of the aircraft are: Length 65ft 6in and wingspan 64ft.

The tail unit consists of monoplane tailplane and a single fin, rather square cut. The RAF production version, the B.Mk.2, has a slightly modified fin as compared with the original style, which is shown in the sketch.

TOP SPEED

Top speed of the Canberra has not been disclosed, but it is so fast that the RAF is considering using a modified version as a night fighter.

The English Electric Co., designers of the Canberra, resumed aircraft manufacture just before the outbreak of World War II after a lapse of many years. In 1938 the company undertook production of the Handley-Page "Hampden," and this was followed by the "Halifax." In all, nearly 3000 aircraft of these two types were built by English Electric.

The company was also entrusted with the production of the "Vampire" jet fighter when the de Havilland Company found itself preoccupied with other important work in the latter part of the war.

English Electric decided to remain in the aircraft industry after the war, and the company set up its own technical and design organisation.

First product of this enterprise, the Canberra bomber, made its maiden flight (under the designation English Electric A-1) in May, 1949.

Tooling up for production of the Canberra in Australia is proceeding. The aircraft will follow the Lincoln heavy bomber on the production line at the Commonwealth Government Aircraft Factory at Fisherman's Bend, Victoria.

LET'S BUY AN ARGUMENT

(Continued from Page 45)

the story. How often have you listened in on big open-air rallies, watched the speakers and performers grimace and perspire with the intensity of their efforts.

What a lark. All that ever comes out of the speakers, half the time, is an offensive, sexless, metallic monotone. You can hear, alright, but you don't want to listen.

It may be necessary to use special speakers and avoid over-heavy bass but it doesn't follow that you have ot employ a "speech" microphone and stupid little condensers in the preamplifier circuit.

If you've ever been the victim of one of these fiendish anti-expression devices, you'll fully appreciate the remarks. I had the unflattering experience only last week.

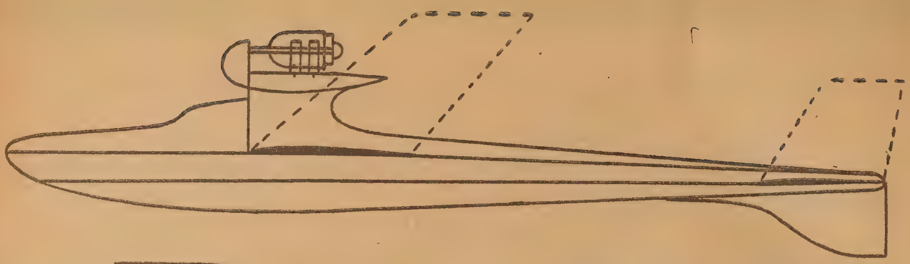
MIKE QUALITY

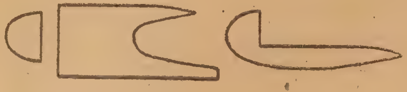
I'm afraid that, in between announcements, yours truly ducked back to the amplifier, plugged the mic. into the pickup jack, turned the gain up full and awaited results. Fortunately, there was just enough gain but, what was more to the point, my voice was restored to its full manly stature.

Please! Just a little more fidelity in the mic. channel. Just a little more forethought to the selection of microphones for indoor and outdoor work. After all, for about three pounds, you can buy an insert which is substantially flat to 8Kc, and that's not bad.

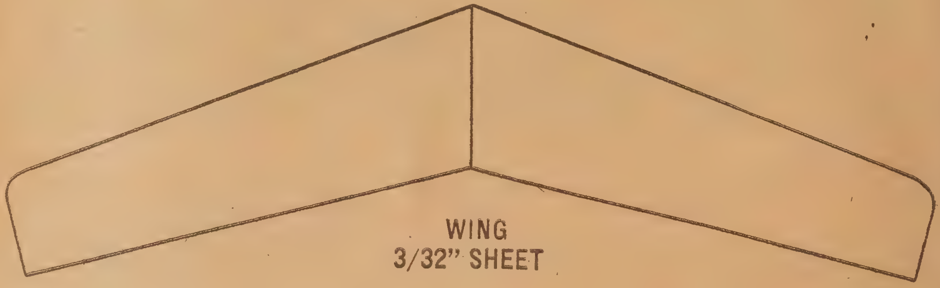
Come to think of it, there's a few more ideas about circuit design I could take a tilt at. I'll have to remember them for next month.

Sulphuric acid is often called the most important industrial acid; during 1949 over 10 million tons of it were produced in the United States.

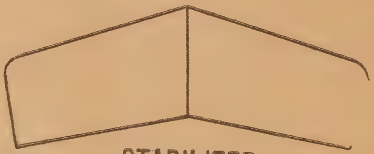




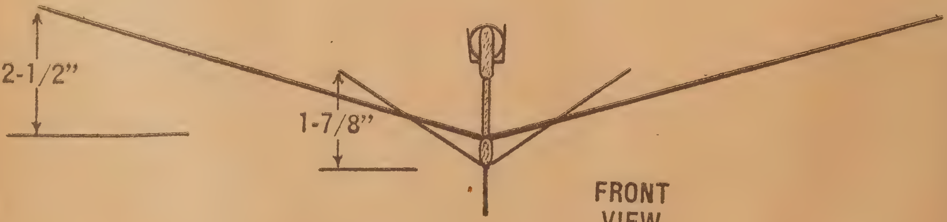
ENGINE MOUNT PARTS
1/16" SHEET
TWO OF EACH
REQUIRED



WING
3/32" SHEET



STABILIZER
1/16" SHEET



FRONT VIEW

SCALE: 3/8" = 1"

A JET PROPELLED MODEL PLANE

Jet propulsion has entered the model flying field. This article tells you how to make a simple flying model using a unit specially made for the job.

by Jack Finneran

THIS little model is developed around the Jetex power unit, a British development of unusual interest which has many applications in regard to model planes cars and boats.

The power unit is manufactured by Wilmot Mansour and Company Ltd, England and is readily available in Australia at the leading hobby shops. It is at present available in three power groups—Jetex 50 for models up to 20 inch wing span, Jetex 100 for models up to 30 inch wing span, and the largest unit, Jetex, 200 which will power craft from 24 to 42 inch span.

The unit which is a particularly clever device, is roughly speaking an aluminium cylinder of about ½ inch diameter with a removable end held firmly in place by three strong spring loaded clamps.

FUEL BLOCK

The fuel is a short solid length, cylindrical in shape to fit the cylinder and resembles a piece of hardwood dowel.

It is ignited by a fuse which is coiled to fit around the charge inside the cylinder and which has one end protruding through a small hole in the centre of the removable end of the cylinder.

The escaping gases passing through this hole, which is of a critical size, provide the thrust. Care must be taken to see that only the piece of wire supplied by the manufacturer is used when it is necessary to clear this hole, as any radical departure from size will seriously impair the thrust available from the unit.

A lot of questions will spring to mind relative to this unit of which the following may well be a few. How does the fuel burn? Is it safe? Does the unit get very hot? How much thrust does it give?

Firstly the fuel is quite safe to handle and is simplicity itself when the directions provided with the unit are followed out.

NOT TOO HOT

It burns with a gentle, hissing sound like the whistle of the wind through the telephone wires. The unit does get hot but not dangerously so and no trouble is likely to arise on this score unless the metal unit is allowed to rest on a doped paper surface. Common sense will dictate that this should not occur.

In the matter of thrust—and this is of prime importance as you can't just add some more power as with rubber bands—you must design your model within definite weight limits. Provided you have kept your weight down and built to a suitable size and design, there is ample thrust for really excellent flying.

Excellent basis for model design suitable to these units is contained in the Jetex booklet which is available with the power unit.

In designing a plane for Jetex power, it is essential to pay some attention to the placement of the unit with a view to securing suitable cooling. A minimum space of 1/6 inch should be left between the engine and any cowls or fuselage side or mounting.

The one thing which one has to be most careful about is the lighting of the fuse which flares up when first lit and poses a threat to the very existence of the model. The use of rather less than ¼ inch fuse projection from the unit and the use of a cigarette for lighting purposes will overcome the fire hazard posed by the fuse.

There is a tendency for the fuse occasionally to shower light sparks from its lighted end, and if you should be using a paper covered model it may be a good idea to protect the possible danger area with a piece of drawing paper or heat resistant paint.

LIGHTNESS

The model presented herewith is basically the design of a hand-launched glider and lends itself admirably to our purpose.

Before starting work on this model remember that the finished ship must be as light as possible. This should present no real problem other than the selection of suitable balsa.

The power from the Jetex units presents little or no stress on a model comparable with rubber power, or the great strain imposed on hand launched gliders when they are hurled skywards with a baseball like throw.

Below is a list of necessary materials. It is advisable to secure quarter-grain balsa, that is, balsa which shows a short grain, and is readily detected by its speckled appearance. This is always rather stiffer than the straight — grained wood and is particularly suitable for this type of ship.

1 x panel balsa 36" x 3" x 1/16" for stabiliser rudder and fuselage.

1 x panel balsa 20" x 3" x 3/32" for wing.

1 x piece balsa 16" x ¼" x ½" for fuselage centre piece.

Start your construction work by shaping the ¼" x ½" stick to shape and size. The bottom of this stick is perfectly straight from nose to leading edge of stabiliser. However, at this point it tapers up to a point 3/32" above the bottom line so as to give the stabiliser when fitted a negative incidence angle of 3/32".

The stick also tapers from the top at a point just behind the wings, trailing edge down to stabiliser as indicated on the plans.

Next we build our wings and stabiliser in the same manner as one does with any hand launched glider. Try to work as good as possible a section into the wing (rather difficult with such thin wings) although, this is not frightfully important.

STRENGTH

Make sure that you get a good strong join in the centre and that you have the correct dihedral angle, to secure adequate flight stability. The stabiliser is fashioned in somewhat similar style and in combination with the rudder features what is known as a Y tail.

This tailplane set up gives the necessary directional and longitudinal stability and keeps the rudder out of the direct path of the jets exhaust gas.

Having secured the wings and tailplane to the main fuselage stick we are ready to attach the silhoutte forms both top and bottom in the interest of appearance.

The motor mount attachment is of prime importance. It is made up from laminated 1/16" panel. Care must be taken to ensure that is has zero incidence and neither right nor left thrust. Mount the Jetex mounts in place on the motor mount and fasten securely with the screws supplied.

Give the complete model one or two coats of dope and lightly polish with sandpaper. It is inadvisable to strive for a high gloss finish or to paint this model as the extra weight added is likely to reduce flight performance to a marked degree.

TESTING

Due to the extreme lightness of the finished model, all tests should be made on a calm day. Trim model by gentle hand gliding tests. In all probability a small amount of modelling clay will be needed on the nose to balance the ship correctly.

(Continued on Page 89.)

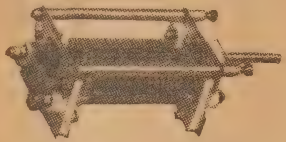
AMATEURS—DISPOSALS—EXPERIMENTERS

MIDGET GENEMOTORS

Input: 28 volts at 1.1 amps. Output: 250 volts at .06 amps. Size: 4½ x 2¾. Weighs only 3 1-8lb. Perfect for use with 32 volt domestic receivers.

32/6

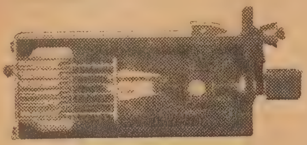
Postage & Packing, 3/-.



TRANSMITTING CONDENSERS

Isolante insulation. Approx. 50 mmf.

10/6 Post Free



NEUTRALISING CONDENSERS

With calibrated Vernier Movement. Excellent for use in H.F. Absorption Wavemeters.

6/- Post Free

No. 11 TRANSCEIVERS

Chassis only, complete with valves, as follows:—
2 1C7G, 2 1M5G, 4 1K7G, 1 807.
Frequency range 4.2 to 7.5 m/cs.

£5/10/- F.O.R.

TACHEOMETERS

0 to 4000 R.P.M. Complete with Generator.

70/-

Postage & Packing, 4/-.

BUZZERS

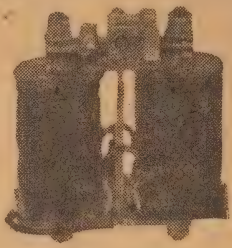
Can be used as a Buzzer or Microphone Transformer.

4/- Post Free

RELAYS

Rotary type using a standard oak switch bank. Can be connected to extra banks for band switching, etc.

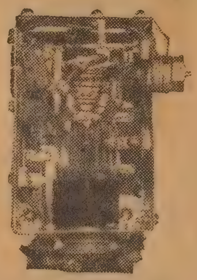
10/6. Postage 2/-.



RELAYS

Twin Coil type, can be adjusted to work on as low as 1 m.a.; extra coil is for use in locking if required.

4/6 Post Free



H.F. OSCILLATORS

Complete with 7193 valve, ready for use. Tuned by a split stator condenser worth this amount alone. An excellent driver for your 144 m/c. Transmitter. Alternatively, modulate the unit as it stands.

15/-

POST FREE

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D.V. type. New in Cartons, Complete with Handset.

70/- F.O.R.

TELEPHONE CABLE

American type, plastic covered in ½-mile rolls. Perfect for use with the above phones.

50/- F.O.R.

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AMMETER
0
1
2
3
4
5

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A.C. AMP. METERS

A.C. Amp. Meters (ex County Council). A necessity in any electrical workshop.
RANGE. 0-5 amps. (can be extended by shunts).
MOVEMENT. 300 degrees.
SCALE LENGTH. Nearly 15 inches.
DIAMETER. 7½ inches.
All instruments checked before delivery which will be the second week in January.

Available also at—
No. 5 Royal Arcade,
Sydney.

PARAGON RADIO

Address all mail to—
Box 14, P.O., Haberfield,
N.S.W.

Quite simple materials are needed to develop your films. A bottle of developer is darkly visible at the left, then comes the clock, fixing bath, and water bath. Only a "safe" light can be used in the dark rooom.

THE ABC OF DEVELOPMENT

Ever thought of doing your own developing and printing? Too difficult? Not a bit of it! You can turn out a commercial looking job at a fraction of the cost and you'll get quite a kick out of doing it, too.

HOWEVER, there is a right and wrong way to do everything, and in this article we hope to put you on the right track, and prevent some of the minor pitfalls of the raw beginner.

Your first requirement is a darkroom, and to avoid an elaborate blacking-out programme, your first experiments had best be conducted at night. Since water and drainage are a distinct advantage, the bathroom or laundry is frequently chosen. The latter is usually preferred, as it does not cause so much inconvenience to the rest of the household. Before making the final decision, check to see that no light leaks are possible, and in particular that a light switched on outside, will not cause a dangerous condition which you did not expect.

Some kind of work bench must be provided, and if the laundry is chosen this may well take the form of a cover to rest on the tubs, that section earmarked for the "wet" operations being made of narrow slats about three-quarters of an inch apart. Thus any slops may be conveniently drained away. If an ordinary table is used its surface should be protected from chemical stain, and this may be done very effectively with two or three issues of the daily paper. These should be discarded once anything has been spilt on them.

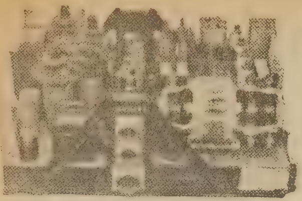
HEIGHT

The height of the work bench is important, and in the interests of comfortable working three feet is about the ideal. If you cannot bring the bench down to this, bring your own standing level up.

The equipment required is not elaborate, and for the developing process the following items will be sufficient: A quarter plate dish (3¼ by 4¼in), two half-plate dishes (6½ by 4¾in), an eight oz measure, thermometer, some form of timing device, and a pair of film clips. A few additional items will be required when you start printing but the above will do to get started.

All these items may be had in a variety of styles and prices, so a brief discussion may not go amiss. Probably the most popular dishes on the market today are the moulded bakelite variety, being reasonably priced, robust and easy to clean. The xylonite variety are not very satisfactory, being of a very flimsy nature, while enamelled steel are expensive, and some types have a tendency to chip badly.

Moulded glass measures are available for a few shillings from any photographic store, and are quite accurate enough for the purpose.



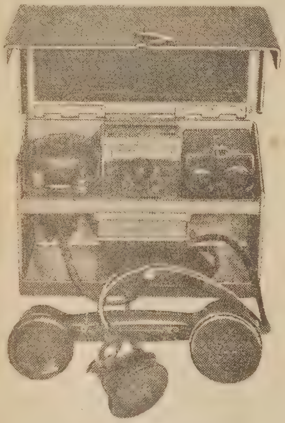
T.R. 1196A. TRANSCEIVERS

This Transceiver is suitable for bush fire Brigade work, &c. Has output of 7 watts, built-in generator to work off 12 volts, D.C. supply. Receiver Transmitter and power supply are all separate units which plug in and make a complete assembly. Receiver uses 6 valves. 2 VR53. 1 VR55. 2 VR56. 1 VR57.

Transmitter uses
1 VT501, 1 VT52, 1 VR91.

Each Transceiver equipped with all valves and in good condition, but less crystals. Both transceiver and transmitter operate on any one of four channels.

Price only £8/15/-



TELEPHONE

These Don 5 Telephones are suitable for the office, farm or factory. Each phone is equipped with new batteries, hand set and buzzer, all are in good working order. Easily installed, simple to operate.

Price £2/15/-

PLEASE NOTE—ALL PARCELS WILL BE SENT REGISTERED POST UNLESS OTHERWISE STATED. POSTAGE OR FREIGHT MUST BE INCLUDED WITH ORDER.

MORSE KEYS

Morse Key (as illustrated on left). The large Bakelite base is adjustable, and is strongly constructed throughout. This key is just the thing for the amateur or the experimenter.
Easily worth 35/-.

Our Price 5/-.

Flameproof Key (illustrated at right). This key is standard equipment in most aircraft. Worth 37/6.

Our price 7/6.

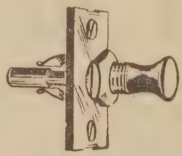
Army Type. A lightweight key for portable equipment. Easily worth 25/-

Our price 3/6.

RECORD PLAYER

This record player uses a well-known brand of English English Electric Motor, and a good English Magnetic Pickup. The unit has a two-pin socket for A.C. connection and shielded lead for pickup. It is extremely light in weight and is beautifully finished in black or brown leathercloth.
Usual price, £15/10/-.

Our Price £8/10/-.



SWITCHES

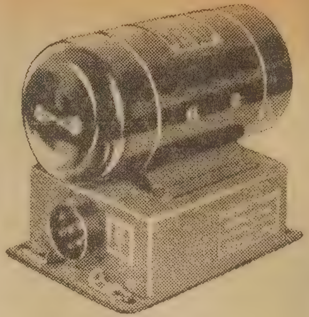
We have just landed a quantity of push-pull S.P. switches as illustrated. These are single hole mounting.

Easily worth 3/6.

Our price 1/3.

ALSO AVAILABLE.

Cutler Hammer Aircraft type Switches, **1/6.**
Single Pole Toggle Switches in Bakelite Construction, 1/[illegible].
Aircraft Type two - way Ignition Switches, with two nickel-plated toggles A very strong switch, 2/-.
Micro Switches in perfect condition, easily worth 17/6. Our price **5/6.**



GENEMOTORS

We have recently procured the following types of generators which are ideally suited for operating radio sets, amplifiers, etc., off 32-volt lighting plants.

Type No. K.S. 557201.
Input. 28 Volts, D.C.
Output. 250 Volts, D.C. at 60 M.A.

Price 35/-.

Type No. D.M. 416.
Input. 28 Volts, D.C.
Output. 330 Volts, D.C., at 170 M.A

Price 45/-.

Type No. P.S. 225.
Input. 28 Volts, D.C.
Output. 375 Volts at 150 M.A

Price 42/6.

Type No. S.5. 2669.
Input. 18 Volts, D.C.
Output. 450 Volts, D.C., at 60 M.A.

Price 30/-.

Genemotor for SCR 522. Input 28 volts. Output 300 volts at 260 M.A. 150 volts at 10 M.A. 14.5 volts at 5 amps.

These are housed in black crackle finished steel boxes and have filter with cooling fan enclosed. An excellent job for heavy duty amplifier work.

Price only £3/19/6.

SPAGHETTI

Genuine woven spaghetti tubing, unaffected by heat, &c. Ideal for set constructors, servicemen, motor mechanics, all prices reduced.

1½ M.M.	**4d per 3ft length.**
2 M.M. 2½ M.M. 3 M.M.	**6d per 3ft length.**
4 M.M. 5 M.M.	**9d per 3ft length.**
7 M.M. 10 M.M. 12 M.M.	**1/- per 3ft length.**
15 M.M. 20 M.M. 22 M.M. 27 M.M.	**1/6 per 3ft length.**

Extra special price for large quantities

MOTOR SPARES LTD.

547 ELIZABETH STREET, MELBOURNE

They are normally available in four, eight, and sixteen ounce sizes, while an ordinary medicine glass will make an accurate one or two ounce size, and a kitchen quart measure is handy for working in larger quantities.

THERMOMETER

An ordinary household thermometer may be used, but those of a wooden base are likely to absorb chemical, and so contaminate subsequent solutions. If a new thermometer is being contemplated, choose one which has the graduations engraved on the glass, as this makes it impossible for them to shift with respect to the column.

The timer may well be the domestic alarm clock, and if it has a second hand, it will also be suitable for making prints. Commercial photo timers are expensive, and usually quite beyond the means of the amateur.

It is wiser not to attempt economy in the matter of film clips, although there may be a temptation to use radio type alligator clips, but most of these metals will react with one or other of the chemicals and this reaction may easily ruin your negatives. Proper film clips are made from stainless steel, and are provided with strong teeth to grip the film.

DARKROOM LAMP

You will also need a darkroom lamp, the exact color depending on the film or paper you are using. The popular roll films such as verichrome, selochrome, &c., are not very sensitive to red light, so this color is usually chosen.

But hold on, don't rush out and buy the first red globe you see, it's not quite as easy as that. The color and brilliance must be carefully controlled, so select a globe specially designed for darkroom use, such as the Philips dark red type B22 or similar. For "gaslight" type printing paper PF723 yellow is about the best, giving a lot of light, but with perfect safety.

Working distance is important, particularly when handling film since even a red light will cause fog if it is too bright. About four feet is a reasonable distance from the type of globes we have mentioned, but in the case of the film it would be advisable to add another two feet to this, as the see-saw method of developing raises the film above bench level.

THE DEVELOPER

Two chemical preparations are required to process the film, the developer and the fixer. The purpose of the developer, as its name implies is to develop the latent image produced by the action of light. When this has been completed there is still present sensitive emulsion which has not been effected by light or developer, and which would quickly blacken on exposure to white light. It is the purpose of the fixing bath to dissolve this unwanted emulsion, and at the same time it is usual to add a hardening agent to toughen the emulsion surface.

One of the most frequent questions asked by the beginner is, "what developer should I use, and how long must I leave the film in it?" The bewilderment can well be understood, for the number of available "brews" appears to be almost unlimited, while each claims to be more or less the last word in chemical achievement.

However, putting aside such special mixtures as fine grain, &c., we find that most of the remainder fall into one group, namely general purpose developers suitable for both films and papers. These are very suitable for the amateur who does a limited amount of work, since they reduce the capital outlay, and ensure that one's stock is exhausted in a reasonable time, before it has a chance to go stale.

> WOULD you like to see more articles on photography? This one is well timed to interest many who have been given cameras for Christmas. Write and let use know if you would like more of them, and if so what subjects or aspects interest you.

In this group we find liquid developers, usually to be diluted with water before use, and powders and tablets which are prepared by dissolving in water. Chemically most of these may be regarded as being similar, and the final choice is often a matter of personal convenience.

The liquid form is certainly convenient, but has the disadvantage of possible deterioration. This is not serious while the bottle is full and tightly stoppered, but once some of the contents have been used, the air in the bottle reacts with the liquid, and its chemical properties are rapidly destroyed. Re-bottling into smaller bottles is one way of minimising this problem, while the deterioration can usually be recognised by a pronounced discoloration of the liquid.

The tablet variety will remain in good condition almost indefinitely, and its most serious disadvantage is that its cost is very much higher than other types.

Powder types do not suffer serious deterioration while in the dry state, and are usually available in packages to make about eight ounces of liquid. This quantity, or more, will usually be required to process one film, so that reasonable economy and minimum waste are usually possible. Any made-up liquid which is not required, may be stored in a full, tightly-stoppered bottle until required for printing.

QUANTITIES

The quantities of developer for different size films will be approximately as follows: 127 size, 4 oz, 120 and 620, 6 oz, and 116 and 616 10 oz The above information may be taken as a safe guide in the absence of any information by the manufacturer, and are on the basis of one film only to the quantity specified.

The question of how long to develop a film is really one for the manufacturer of the developer, and it is an unfortunate fact that many manufacturers are either unwilling or unable to supply this very vital piece of information. Their product may be quite satisfactory from a chemical point of view, but without the knowledge of how to use it, it is practically valueless. It is true that in some cases a little information is included on the instruction label, but it is usually limited to one or two general film classifications at one temperature.

The beginner is thus faced with the problem of what to do if the temperature happens to be other than that stated, or if the film he is using does not seem to fit into either of the classifications given.

Fortunately there are developers available which are supplied with adequate information, listing large ranges of film makes and types, with their development times at all practical temperatures. Before you decide on a certain developer therefore, make sure that you can obtain the information on how to use it.

The fixing bath is very easy to prepare, a simple version consisting of 16 oz of hypo in 80 fluid oz of water. The mixing will be easier if the water is warm, say about 120 degrees F. This may be regarded as a stock solution which does not deteriorate.

FIXING & HARDENING

At the same time as the film is being fixed it is convenient to harden the emulsion, and it is also desirable to make the fixing bath slightly acid, so that it stops the action of the developer immediately. All this may be accomplished with a ready-mixed acid hardener solution, available in a number of brands. This is usually added in the proportion of one ounce of hardener to 16 of hypo, preferably just before use. No difficulty will be experienced in knowing when the fixing bath has done its job, as it produces a visible change in the emulsion, and a little extra time will do no harm.

Four ounces of the above solution will be sufficient to fix one 120 or 116 film, or two of 127 size.

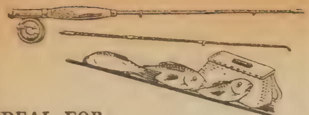
Be very careful that none of this solution comes in contact with the developer, even the small quantity which you can transfer on your fingers being enough to ruin its developing properties.

From what we have told you so far you should be able to build up a kit of apparatus exactly suited to your needs, and having done so you will be ready to develop your first film.

GETTING STARTED

The first thing to do is carefully prepare the various solutions, and no doubt you have been wondering why we specified three developing dishes, when only two solutions have been mentioned. Well the third dish is used for a water bath, through which the film is passed before going into the developer.

The importance of temperature has



IDEAL FOR THE HOLIDAYS

2-Piece Steel Fishing Rod ..	12/6
Bakelite Reel	5/9

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Vacuum Gauges, 0.30in.	27/6
Pressure Gauges, 0-200lbs. ..	25/-
12 volt, 17 amp Accumulators	89/6
Car Tow Ropes, 13ft. long ..	9/6
Gasket or Workshop Snips ..	4/9
English Barbers' Scissors, Pr.	12/6
Brand New Micro Switches ..	6/-
Hobbyists' Drills. Doz.	6/-
Morse Keys and Buzzer. Ideal for Boy Scouts. Cost £5, for	10/-
Genuine British 4-draw 22 magnification Rifle Range Telescope	£6/19/6
Pocket Compasses, English ..	5/9
Pocket Telescopes	12/9
Pocket Folding Telescopes, optic glass lenses. Good range	37/6
Workman's Tool Bags, made from solid leather and canvas. Ideal for plumbers or bricklayers. 18" x 8". Each	12/6

Finest Quality Waterproof and Rot proof Tarpaulins.
9 x 9 .. .. £4/10/-
8 x 10, £4/15/-. 9 x 15, £7/15/-. 9 x 12, £5/19/6. 12 x 12, £7/15/-. 12 x 15, £9/5/-. 18 x 14, £13/10/-. 18 x 16, £16/10/-. 20 x 18, £19/19/-. 30 x 20, £33/10/-.

English Spiral Screwdrivers .	16/6
Stainless Steel Pocket Knives, with 2 blades	8/6
American - style Expanding Wristlet Watch Bands, chrome plated	9/6
Gold Plated	16/6
Brand New English Pendulum Type Kitchen Clocks, Cream and Green	35/-
Pocket Type Spark Plug Testers	6/6

No motorists should be without one.

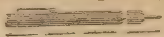
Extra large size Air Compressors 5.5 cubic feet	£19/19/-

METERS — METERS

Weston Double Reading Milliampers 0-40-0-120	25/-
English AC-DC, 0-150 ampmeters 3½" dia. 57/6 R.F. Meters by taking out thermo couple will read 0-4 milliamps	12/6
Metro Vickers 0-1 milliamp Meters, 3¼" diam.	32/6
Metro Vickers 0-15 volts, 0-600 volts, full scale 0-500 microamps	25/-
AC-DC 0-20 Milliameters, 2¾" diam.	23/6
Brand New Weston 0-50 volts, 0-100 amps combined	£3/10/-
0-3 amp Meters	30/-
0-10 amp Meters	30/-

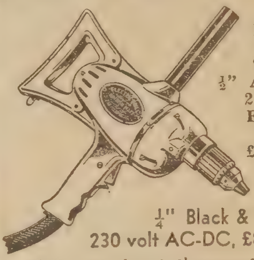
POCKET SCREW-DRIVERS

Brand new. 5 in 1. Made in England 5/9



Ideal for engineers, mechanics, hobbyists. Carry it in your pocket. 5 screwdrivers in one.

REDUCED PRICE



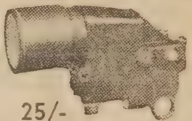
British Made "Wolf" ½" AC-DC 230 volt Electric Drills, £15/3/9

Also ¼" Black & Decker 230 volt AC-DC, £8/19/6

Never again at these prices. Brand new. Limited Stocks available

Grinding and Buffing Sets to suit Black and Decker Drills 25/-

ARMY GUN SIGHT



Brand New

25/-

25/-

Has excellent lens to make small enlarger or film projector.

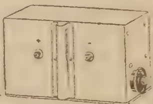
IDEAL FOR HOME LIGHTING PLANTS

RAAF BATTERY CHARGING GENERATORS

24 volt 1500 watt £13/15/-
Brand New English Lucas, 12 volt 500 watt. Also 24 volt £10/15/-

AT LAST

Complete Battery Charger



Fitted with brand new English Silenium Rectifier

Works off 230v. A.C. Household Supply.

Charges any battery from 2 to 6 volts at 5 amp. £5/15/- complete.

Flexible Silver Cine Screens, 6ft. x 42". Each 12/6

Electric Arc Welder. Set works off any car battery, 6 or 12 volt, complete with carbons & rods 29/6

SURPLUS

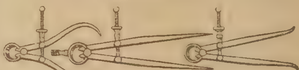
512 ELIZABETH ST., MELBOURNE, C.1.
PHONE: FJ5904. Just 4 doors from

AT LAST — BRAND NEW ENGLISH ARMY SPOTLIGHTS

Ideal for Rabbit Shooting

32/6
Complete with Cord

Available in 6 or 12 volt.
Fit One to Your Car.



Engineers' Special Outsize Screw Calipers, 4" Dividers and inside Screw Calipers, each 4/6

BRAND NEW AIR COMPRESSOR
2.2 cubic feet will pump up to 75lb.

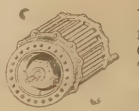
Never before at this price.

Ideal for spraying.

£9/10

R.A.F. AIR PUMPS AS USED IN LINCOLN BOMBERS

Can be used as Low Pressure Compressors or for Low Pressure Spray Guns, Brazing, Glass Blowing or Tinning, etc.

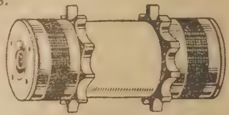


Useful for Gas Torch

55/-

24-volt A.C.-D.C. Geared Electric Motor

100 REVS. PER MINUTE VERY USEFUL. WORKS OFF 32 VOLT LIGHTING PLANTS.



£2/2/-, cost £6/15/-

SURPLUS STORES

PLEASE ADD FREIGHT OR POSTAGE

Mail Orders Carefully Packed

STORES

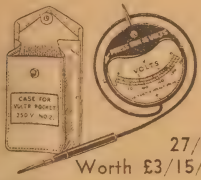
512 ELIZABETH ST., MELBOURNE, C.1.
Victoria Street. PHONE: FJ5904.

Cake Mixers, water driven, works off any water tap, as good as electric. Cost £7/7/-. Our Price 39/6

Genuine English RAF Flying Goggles Mk. 7. Pair 37/6

Headphones—
Brand New 27/6
Secondhand 15/-

AT LAST! British Army Issue
DOUBLE SCALE VOLTMETER
0-15 0-250 VOLTS



CASE FOR VOLTR POCKET 250 V NO.2.
VOLTS

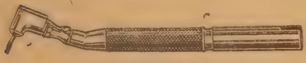
IDEAL FOR BATTERY SET USERS AND DEAF AID USERS OR HOBBYISTS

27/6
Worth £3/15/-

RAAF AIRPLANE COMPRESSOR

Two stage.
Limited Numbers.
Highest Quality.
£5/5/-

DRILLING OR ENGRAVING



HANDPIECE

Brand New .. .. 20/- each
Burrs, 2/6 packet of 5.

AT LAST; DALTON COMPUTORS. IDEAL FOR AERO CLUBS A.T.C., ETC.

Only Limited Stocks Available. Be Early. 35/-

BRAND NEW ENGLISH VERNIER CALIPERS

Will measure inside and outside. Can also be used as Depth Gauge.

22/6

Ideal for all types of engineering work. Measures in ins. and m/m. Can be carried in the pocket.

Army Groundsheet and Cape JUST ARRIVED

Ideal for campers, cyclists, hikers.

16/6

Direct from English Army disposals.

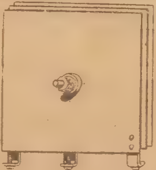
THIS IS NEWS. GENUINE R.A.F. WATERPROOF FLYING SUITS

Made in England. Brand New.

Ideal for Flyers, Motor Bike Riders, Farmers, Tractor Drivers. Heavyweight Waterproof Material. Fitted with Zip Fastener Front. £5/19/6.

Brand New ENGLISH RECTIFIERS

Make yourself a battery charger.



6v 2 amp ..	24/6
6v 5 amp ..	32/6
6v 10 amp .	57/6
12v 5 amp .	57/6

Transformers to suit above Rectifiers. 2 and 5 amp 37/6

A Lucky Repurchase.
£3/19/6
Brand New Army Phones Ideal for Farms

Install one in your workshop or house. Equal to P.M.G.

BRAND NEW CAR FIRE EXTINGUISHER

Pyrene
MADE IN U.S.A.

Genuine Pyrene. Fit one to your car.

Made in U.S.A. Worth £5/15/-.

OUR PRICE £3/5/-.

Ideal for Trucks or caravans.

Limited Quantity available.

Perspex Sheet takes the place of glass. Ideal for car windows, etc.

24 x 18 3/32"	**£1/12/6**
22 x 14 3/16"	**£1/1/-**
18 x 12 3/16"	**17/6**

Celluloid Sheet, 54" x 24" .. .. 11/6 sheet

PHOTOGRAPHIC BROMIDE PAPER—KODAK

Fraction of New Price

5½ x 5½	5/- per pkt. 144
8½ x 6½	12/6 " " "
9½ x 7½	17/6 " " "
10 x 10	22/6 " " "

WATCHMAKERS AND INSTRUMENT MAKERS

English Tweezers	5/6
English Pin Vices	6/6
Single Drivers, 5 sizes, 2/6 to	3/6
Eyeglasses	6/6 & 8/6
Extra strong double lens eyeglass	15/-

SURGEON'S SCALPELS

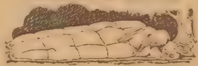
SMALL 4/6
LARGE 5/6

Many other uses—Hobbyists, Chiropody, Photography, etc.

Brand New American Vacuum or Air Pump

Builds up air pressure to 30lbs. at 1000 R.P.M. Develops up to 120lbs. per sq. in. of hydraulic pressure, will pump 7½ gals. S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems £3/15/-

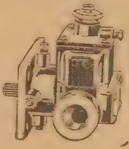
Just what you have been waiting for GUARANTEED WATERPROOF SLEEPING BAGS



Why buy a tent for your holidays? Ideal for campers. Carry one in your car for emergency £4/15/-

BRAND NEW AMERICAN PUMPS

USED BY THE R.A.A.F.



STAINLESS STEEL VANES

WILL PUMP ANY LIQUID

400 gals. per hour	55/-
200 gals. per hour	50/-

LUCKY RE-PURCHASE AMERICAN DELCO 24-VOLT MOTORS

55/-
Will work off 32 volt lighting plants.

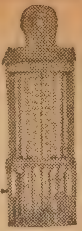
Limited Number Available.

Telephone FJ5904

INCLUDE STATE IN ADDRESS

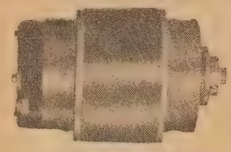
and Efficiently Despatched

HYGROMETER



For Temperature and Humidity readings, as supplied to the Air Force. No Home, Farm, Factory or Dairy should be without one of these. Price 19/6

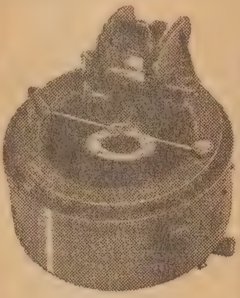
Postage and Packing; Vic., 1/6, N.S.W., S.A., Tas., 2/-; W.A., Qld., N.T., 2/6.



SELSYN MOTORS

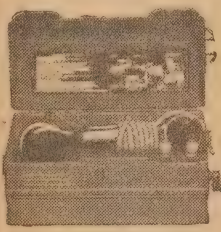
50 volt 50 cycle, ideal for use with Rotating beam aerials 30/-

Postage and Packing: Vic., 2/-; N.S.W., Tas., S.A., 3/6; Qld., N.T., W.A., 5/-.



COMPASS

Liquid Damped, Card Type. 6½" dia. x 3½" deep, fitted with large viewing prism, ideal for small craft, etc., for normal navigation and also taking bearings. Each £6/10/-



ARMY FIELD TELEPHONES

Ideal for use in woolsheds, indoor or outdoor communications up to 5 miles. These are English "H" Type phones, very similar to the Australian "L" type except that they incorporate a voice-powered handset and do not require batteries. Also a "C" Type generator and bell is installed. Price, per set of two phones and 100 yard reel of wire .. £9/10/-

Additional Phones £4/7/6 each.
Extra wire, 100 yards .. 17/6

Waltham TRADING Co

393 Flinders St., Melbourne, C.1.
Mail Orders Dept.: 319 Swanston St., Melbourne

SPECIAL NEW YEAR OFFER!!

8 day Clocks by the Famous Waltham Clock Co. of America. Ex-U.S. Navy, 24 hour Luminous Dial, showing date, hours, mins, secs. Size 3½".

Worth £25.

Our price £9/10/-

DINGHY MASTS AND SAILS

Light Dural Telescopic seven-section mast, 5ft. 6in., and Triangular Sail, 5ft. 9in. by 4f. 6in. of lightweight material, complete with guy ropes. TWO OF THESE SAILS SEWN TOGETHER WILL MAKE AN IDEAL BEACH SHELTER. Postage, 1/6. 7/6

METAL DETECTOR

The wartime mine-detector is now doing a very useful peacetime job, and has proved invaluable to PLUMBERS, GAS FITTERS and MUNICIPAL COUNCILS. It originally worked on the principle of finding the metal casing of mines. Metal pipes and cables can be traced quite easily in the ground. This saves the laborious, costly and time-wasting digging of "search holes," when the underground path of the pipes is uncertain, as it frequently is. The units contain two interchangeable sweep coils, one large and one small, and pack complete with valves and headphones. Packed in stout wooden transit case, 10" x 12" x 4' 6".
Total weight, 80lbs. PRICE, each £8/10/-

TANK WHIP AERIALS

Two four foot sections, ideal for car aerials, or fishing rods. Each 15/-

R.A.A.F. NAVIGATORS' PLOTTING BOARDS

18" x 18", complete with Pantograph 17/6

ELECTRIC MOTOR

50 volt, 50 cycle. Can be rewound to 1/10th H.P. 230-volt A.C. Diameter of shaft 3/8in, self aligning ball races.
EACH 35/-
Postage and Packing: Vic., 2/9; N.S.W., S.A., 5/-; Qld., N.T., 7/3.

SPECIAL SLOW SPEED MOTOR

24-volt, approx. 1/6 H.P., reversible motor, fitted with 5000 to 1 reduction gear and magnetic Brake.
EACH £2/17/6
Postage and Packing: Vic., 2/9; N.S.W., S.A., 5/-; Qld., N.T., 7/3.

BLOWER MOTORS

80-volts D.C. with laminated field, approx. 1/10 H.P. 45/-
Postage and Packing: Vic., 2/-; N.S.W., S.A., 3/6; Qld., N.T., 5/-.

COMBINED MOTOR AND PUMP

Combined 24-volt motor and High Pressure Hydraulic Pump, 600lbs./square inch £3/15/-

ELECTRIC MOTORS

24-volt, A.C., D.C., 1/40 H.P., with laminated field 50/-
Postage and Packing: Vic., 1/6; N.S.W., S.A., 2/6; Qld., N.T., 3/6.

AIRCRAFT MAGNETOS

Seven cylinder, containing magnets, ball races and many useful parts. EACH 25/-

RUBBER DINGHIES

Just the thing for your holidays, easily inflated, will hold a family of eight £8/10/-

HIGH IMPEDANCE HEAD PHONES

4000 ohm, suitable for crystal sets.
PRICE, per pair 25/-
Postage and Packing: Vic., 1/-; N.S.W., S.A., 1/6; Qld., N.T., 2/-.

ALL GOODS CONSIGNED "FREIGHT PAYABLE ON DELIVERY" UNLESS OTHERWISE STATED — SORRY! NO C.O.D.

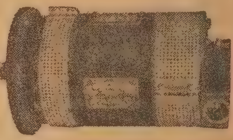
BELL-RINGING HAND GENERATORS

Suitable for installing in the Don V Telephone to convert to Bell Call System 37/6

Postage and Packing: Vic., 1/6; N.S.W., S.A., Tas., 2/3; Qld., W.A., N.T, 3/-.

R.A.A.F. ASTRONOMICAL INSTRUMENT can be utilised to measure horizontal and vertical angles such as those encountered in road making and irrigation work. It is fitted with scales calibrated in degrees, two levels and adjustable turntable mountings £2/15/-

Postage and Packing: Vic., 2/-; N.S.W., Tas., S.A., 3/6; Qld., N.T., W.A., 5/-.



JUST ARRIVED FROM ENGLAND

BATTERY CHARGING GENERATORS

Suitable for Home Lighting Plants, &c.

24 volt—1500 watt	..	£15 0 0
12-volt— 750 watt	..	£12 10 0
12-volt— 500 watt	..	£10 10 0

The 24-volt—1500 watt generator can be used for 32-volt systems without any alteration.

BENDIX REGULATOR AND CUT-OUT

24-volt, can also be adjusted to operate on a 32-volt House lighting system. EACH £3/10/-

already been mentioned, and there are a few points to watch in this regard. In order that the temperature of your solutions, and in particular the developer, will remain constant, it is very desirable to work at room temperatures, and no attempt should be made to warm or cool them.

This really makes things very simple and was the reason we stressed the importance of adequate information with your developer. The only other thing likely to cause variation is the temperature of the tap water, which often differs considerably from room temperature.

This problem is very simply overcome by filling a quart bottle with tap water and storing it in the darkroom for a couple of hours before use. Refill it after each session and it will be ready for the next time. This supply is used to mix your developer, and also for the water bath. The fixing bath is not so critical, but it is unwise to subject wet films to sudden changes of temperature, the effect being to "reticulate," or wrinkle the emulsion.

It is a help when unrolling the film to have handy a secure hook on which a film clip may be hung, and a short rod to serve as an axle for the film spool.

With all solutions prepared, turn out the white light and make a final check for possible white light leaks.

It is best to wait a few minutes, allowing the eyes to adjust themselves, before pronouncing the conditions safe.

THE FILM

If all is well, break the seal on the roll of film and unroll the protective paper until the free end of the film is reached. Attach one of the film clips to the free end and fasten the clip over the hook. Pass the axle through the spool and unwind the remainder of the film, the other end of which will be fastened to the paper backing. Keep the film taut and detach the paper, then allow the film to roll up towards the clip, using its own natural curl. As far as possible avoid handling the emulsion surface, working with only the extreme ends or edges of the film.

Now take the film clip in the right hand, and holding the edges of the roll in the left hand, immerse it in the water bath. Draw the film clip away from the roll until it is completely unwound, but be sure to keep control of the free end with your left hand. Repeat this several times until the film loses its natural curl and becomes limp and easy to manage. Do not skimp this operation, as a curly film can be very difficult to get on with. When you are sure that the film is quite limp, attach the second film clip, and drain off any surplus water.

DEVELOPING

Note the time and transfer the film to the developer, passing it through the solution from end to end, using a see-saw motion. In about half a minute images will start to show on any reasonably exposed negatives, and will darken fairly rapidly. At this stage the beginner usually panics, for in a very short time the images will appear so dark that he is convinced that they are hopelessly over developed, and is tempted to immediately transfer them to the fixing bath. This illusion is caused by the weak light, and also the opaque nature of the emulsion at this stage, so continue with the development for the correct time.

Also, don't worry about different negatives having different densities. This is quite normal, and is a function of the exposure, but has no bearing on the development procedure. The different densities will be easily set right in the printing.

Having completed the development time, transfer the film to the fixing bath and after half a minute in an acid fixer the white light may be safely turned on. It is probable that the creamy emulsion will have already commenced to disolve, and the fixing should be continued until all traces have vanished. No harm will result from a little longer, and it is often recommended that the process be continued for twice the time taken to remove all visible traces.

The film must now be washed, otherwise the hypo and other chemicals held in the emulsion will slowly destroy the image. About 30 minutes in running water is required, and a good method is to lay the film, emulsion (dull) side up, on the bottom of the bath, and turn the shower on it. A small weight of some kind may be necessary to prevent the film drifting down the bath, and the shower stream should be directed on to one end of the film, the water flowing over the remaining surface on its way to the drain.

After washing, the film should be hung to dry in a dust free location, and any surplus water may be removed by running clean fingers gently down each side of the film. The film is best left overnight to dry, and once this has commenced it is best not to disturb it or move it from one place to another.

When dry, the film may be cut into individual negs, and stored until you are ready to print them.

Special Note: Most developers, if spilt on clothing, will produce a brown stain which is very difficult to remove, so don't wear your Sunday best in the darkroom.

THE usefulness of any camera will be increased many times by the use of a portrait attachment. The humble box camera, normally restricted to a minimum working distance of about ten or twelve feet, will benefit as much as any, since it can now be used at a distance of 30 to 36 inches. These supplementary lenses are designed to fit in front of the normal lens, and operate by altering its focal length. When purchasing such an attachment it is best to take your camera along to the store, to make sure you get one to fit your lens mount.

The cost of one of these units is only a few shillings, so there is no excuse for the blurred out-of-focus efforts one frequently sees as the result of someone's attempt to photograph the dog or cat or similar small objects.

POCKET RADIO

"COMMANDO" POCKET RADIO READY A.B.C. EASY TO ASSEMBLE KITS
£4/7/6

Same as used by World's War Resistance Movement Spies, Agents, etc., or Learn, FIX, BUILD any Radio, big Radio Kit. A.B.C. Plans, Practice Parts and 21 Lessons supplied.
PRICE £8/19/9.
GET FREE BOOKLET—"RICH REWARD IN RADIO"—MAKE MONEY AT HOME.

MYSTERIOUS DEVICE WELDS
ANYONE CAN OPERATE
Now an ELECTRIC ARC WELDER WORKS INSTANTLY from any 6-volt Battery. Does 1000-1 jobs, amazingly low costs, on iron, aluminium, steel and all metals. INDISPENSABLE for auto, factories, garages, all workshops, farms, engineers, railroads, bicycle, motor repairs. Anyone can handle without skill. PRICE £8/19/9. 12 lessons with free welder.

ELECTRO-PLATING AT HOME
A child can use! Works with or without battery, just paint on. Replates all metals, bumper bars, headlights, 2031 articles, nickel, copper, silver, gold, zinc, brass, tin, etc., without dismantling. Complete outfit free. 3 lessons £8/19/9 with free electric plater.

MAGIC PLASTICS
MAKE MONEY AT HOME!
No experience required.
EARN UP TO £7 WEEK.
Amazing Re-Nu Outfit — 75 Money-Making plans, 500 Secret Formulas. Learn decorating, manufacturing, plastics, etc. How to make Rubber Moulds, 3d., 6d. ea., reproducing thousands novelties, sell at 10/6 to £5/5/- ea. to Friends, Stores, etc., or we buy, or supply list of buyers. 3 lessons £8/19/9 with free moulding kit.

POST THIS ORDER NOW.
RE-NU CO., 72 SWAN ST.,
R'MOND, VIC. Enclosed please find M/O., Chq. for £ .... or send C.O.D. Or send me free
INDICATE CHOICE.
folder on................................
NAME....................................
ADDRESS..................................
.... R. & H. Jan., '51.

ROYCE RECORDING DISC
SPEAKS FOR ITSELF
BLANKS FOR AMATEURS
From 1/9 to 5/-.
Write for new catalogue of prices and latest information for recordists.
PLAYBACK RECORDING SUPPLIES
BOX 5041Y, G.P.O., MELB., VIC.

SHORT WAVE NOTES BY RAY SIMPSON

CANADA BROADCASTS TO AUSTRALIA-N.Z.

According to information received from Radio Australia, the Canadian Broadcasting Corporation is to extend its South Pacific service to Australia and New Zealand to two programmes weekly instead of one as at present.

COMMENCING on Sunday, December 31, 1950, they will give these programmes on Sundays and Wednesdays from 6.40 pm to 7.50 pm, and, we presume, use the same stations as at present, CKLO, 9.63 mc, and CHOL, 11.72 mc. These programmes have been very popular right since their inception and have always been heard at excellent strength in eastern Australia. The United Nations' broadcasts from the Canadian stations are also being heard quite well just now, these transmissions being given over CHOL on 11.72 mc and CKLX on 15.09 mc from 2.0 pm to 2.20 pm, Mondays to Fridays.

ANKARA TO EXTEND SW SERVICE

For some weeks now we have been hearing the new 100 kw Ankara transmitter operating over TAS on 7.285 mc, and also TAT on 9.515 mc and TAV on 17.84 mc. The well-known New Zealand listener, Jack Fox, has recently received advice from the station that next month they will take into use another transmitter, this one being of 20 kw power.

The call letters allotted to this station TAN 6.0 mc, TAM 7.24 mc, TAK 11.76 mc, and TAD 17.72 mc. Listeners should keep a look-out for any of the above stations, as they should be heard quite well in Australia, though possibly not quite as loud as the 100 kw one. In case you have mislaid the list of calls for the latter transmitter, here they are again: TAS 7.285 mc, TAT 9.515 mc, TAO 11.88 mc, TAU 15.16 mc, TAV 17.84 mc, and TAX 21.66 mc.

WITH OUR REPORTERS

WE have always been very interested in receiving reports from listeners giving details of what they have been hearing, and quite recently we have been pleased to give advice to a number of new listeners who have just taken up our interesting hobby. It is surprising how soon these listeners become adept at identifying the many stations now on the air, and their logs would do credit to those who consider themselves experienced listeners.

We would like to remind all newcomers that we are always very pleased to provide them with any information they require if they will send their inquiries to the writer, enclosing a stamped envelope.

It is not always the young listeners who write to us, as quite recently we received a most entertaining letter from a gentleman in Sydney who is over 80 years of age and who is a most enthusiastic listener. Letters are not confined to Australia, as we have had more than one letter from overseas, the latest being from a Mr. Jens Frost, in Copenhagen, Denmark, who sent us the latest schedule of the Polish stations.

A Mr. John Johnson sent along a list showing the number of verifications he now has, which, incidentally, is 517 on short wave and 70 on the broadcast band. Only last week we heard from a Mr Keith H. Howard, from Cessnock, NSW, who kindly sent us the latest schedule for Radio Moscow. These and other letters are always welcome

DUTCH TRANSMISSIONS TO KOREA

It is unfortunate that it should be the tragedy of war which is the means of bringing us so many interesting short wave broadcasts and it brings back the days of World War II when we describe a recent transmission we heard from Holland.

THE programme consisted of messages to the troops in Korea, transmitted from Station PCJ in Huizen on 15.22 mc. The programme was all in Dutch and opened with the usual stirring band music, followed by a talk in which frequent mention was made of Korea. Immediately after this, various people were introduced to the microphone and they sent messages to their relatives who were apparently in the armed forces in Korea.

Although, as we say, this broadcast was in Dutch, no difficulty was experienced in distinguishing the difference between the announcers and the other people who were broadcasting. It was usually the father and mother and quite often children also spoke to their fathers overseas and, owing to the emotion of the people concerned, it was rather distressing to listen to. Many of the people concluded their message with a kiss, and we can well imagine how thrilled the men in Korea would be when they heard their loved ones speaking to them. The strength of the broadcast was excellent and quite possibly it was beamed to the Far East to ensure good reception in Korea.

WARSAW SW SCHEDULE

POLAND has recently extended its short-wave service and Warsaw III is now transmitting on three frequencies, 6.22 mc, 7.205 mc, and 9.528 mc. All of these channels can be heard in Sydney, the best being 6.22 mc and 9.528 mc, though 7.205 mc is also audible. These stations are on the air as follows:—

6.22 mc: 11.45 pm to 12.15 am, 12.30 am to 2.0 am, 3.15 am to 3.45 am, and 4.0 am to noon (Mon. to 9.0 am).

7.205 mc: 6.0 am to 7.30 am, 8.30 am to 8.45 am.

9.528 mc: 3.0 pm to 5.5 pm, 11.45 pm to 12.15 am, 1.30 am to 2.0 am, 3.15 am to 3.45 am, 4.0 am to 5.0 am, 9.0 am to 9.15 am, and 11.0 am to 11.30 am.

The various language broadcasts are as follows:—

Programme in English: 3.15 am to 3.45 am on 6.22 mc and 9.528 mc, 4.30 am to 5.0 am on 6.22 mc only.

Programme in French: 4.30 am to 5.0 am on 9.528 mc only, 6.0 am to 6.30 am on 6.22 mc and 7.205 mc.

Programme for Poles abroad: 4.0 am to 4.30 am on 6.22 mc and 9.528 mc, 6.30 am to 7.0 am on 6.22 mc.

Programme for Poles in USA: 9.0 am to 9.15 am, 11.0 am to 11.30 am, on 9.528 mc.

SHORT WAVE NOTES for the February issue are due on January 12. For the March issue they are due on February 5th. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord West, N.S.W.

FLASHES FROM EVERYWHERE

MALTA: Here are the latest operating times for the Forces Broadcasting Station in Malta received direct from the station by a recent mail. Sunday: 2 pm to 7 am (Mon.) on 1484 kc and 7.22 mc, from 2 pm to 6 pm on 6.015 mc; 7 pm to 1.45 am (Mon.) on 11.895 mc. Monday to Friday: 2 pm to 4.15 pm on 1484 kc, 6.015 mc and 7.22 mc; 7.30 pm to 1.45 am on 11.895 mc; 2.15 am to 7 am on 6.015 mc. Saturday: 2 pm to 4.15 pm on 1484 kc, 7.22 mc and 6.015 mc; 7.30 pm to 7 am (Sun.) on 1484 kc and 7.22 mc; 7.30 pm to 3.30 am (Sun.) on 11.895 mc. Practically all of the above channels can be heard, the best being 6.015 mc around 6.30 am though 11.895 mc is also very good around midnight.

GUATEMALA: From the Universalite we learn some details regarding a new shortwave station which has commenced operations in Guatemala. This newcomer has the call letters TGNA, which are supposed to stand for Telling Good News Abroad. The station is a Gospel Missionary station and operates on 6.04 mc, their address being Apartado Postal 601, Guatemala City, Guatemala.

They are being heard in the USA around 1 pm, Sydney time, and at that time have announcements in English. They were recently heard to announce that in the near future they would also be using 11.85 mc and at a later date 9.66 mc. We suggest that Australian listeners watch out for them on these two frequencies as they would be heard better here than the 6.04 mc.

AUSTRALIA: There are many interesting stations located in Australia which operate on many different frequencies, depending on the nature of their broadcasts and the time of the day, season, &c. Many of these stations have the prefix VH or VL and can be heard at all times of the day and night.

Recently we logged one of these stations on 9.23 mc opening at 10 am, when it gave the weather conditions at their location and other information concerning the particular nature of their duties. Some of the most interesting are the Forestry and Fire Fighting units located in all different States and it is quite interesting listening to them chatting to each other. The flood relief stations are also of topical interest at this time.

CHILE: Once again per favor of the Universalite we find details of two Chilean stations which quite possibly may be heard in this country. The first of these is CE920, located in Punta Arena, and as can be noted by their call sign, operates on 9.2 mc. They have been heard with an opera programme till leaving the air around 1.0 pm with a march.

The second station operates on 11.8 mc and is located in Santiago de Chile. The programme from this one is provided by the Swedish Chilean Culture Institute and takes the form of a session in Swedish every month on the last Sunday, the transmitting time being noon, EAST. On favorable days it should be possible to log both these stations.

GREECE: Art Cushen sends us some details of Greek stations which are of interest to many listeners in this country. One of these stations is the Central Greek Forces Station, which operates on two frequencies, 6.23 mc and 6.33 mc, and can be heard in New Zealand on Sundays around 2.30 pm when they have a church relay. They commenced operations on October 28 and are using 9000 watts, reports being asked for from listeners who may hear them.

Other NZ listeners report having heard this station around 5.30 am but interference is rather heavy at that time. Jannina, 5.98 mc; Larissa, 6.745 mc; Tripolis, 7.0 mc; Athens, 2 6.34 mc; Athens, 3 7.05 mc; Makronesio, 7.065 mc; Kavalia, 7.59 mc and Macedonia, 7.95 mc.

STILL MORE NEW STATIONS

CEYLON: The Commercial Service of Radio Ceylon has now greatly extended their operations and during the past month have been heard on 3.32 mc, 7.19 mc and 11.975mc. The best of these channels is 11.975 mc, which is really good at midnight, when the programme is in English. The same programme can be logged on 7.19 mc, though strength is rather weaker.

Prior to the above time, Radio Ceylon can be heard with the native-type programme, which, although not very interesting, is rather fascinating at times. We imagine reports sent to Radio Ceylon, Torrington Square, Colombo, Ceylon, would bring along a verification.

MOZAMBIQUE: Our radio friends in Lourenco Marques are rather notorious for changing frequency and then disclaiming that they operated on the particular channel in question. This makes us rather dubious at mentioning one of the CR7 stations which we are now hearing every morning at 6.30, operating on 7.26 mc. At first we thought this to be a second spot of some other outlet, but it now seems like a fundamental frequency.

They announce as being in the 25 and 60-metre band when they leave the air at 7.0 am with the Portuguese National Anthem after the usual programme of western type recordings. Strength is quite good, though they suffer from interference from Tangier on 7.27 mc.

INDIA: As we have not received a current schedule from All India Radio for some time now, it is very hard to follow their many transmissions and impossible to tell which of the many VUD stations you are listening to. However, we have noticed two new outlets recently, the first and loudest being on 21.7 mc and the other on 17.74 mc.

These stations open at 5.30 pm with an English transmission, the first being lunchtime music till 6.0 pm, followed by the news in English. The 13-metre band station is especially good, being much louder even than their other outlet on 21.51 mc, which is always good at that time.

UNITED STATES: Once again there are a few new ones from USA, and as a change from the regular stations we have heard for so long are WMF56 on 6.89 mc, and WMF29 on 9.01 mc. These stations operate from 4.0 pm to 7.0 pm with a programme entirely in Chinese, and as a matter of interest are relayed by VLA6 on 15.2 mc. Other new ones are WRUL on 9.7 mc, which comes on the air at 7.0 am, and WLWO1 on 15.23 mc, heard at the same time at quite good level.

Although not strictly USA, we will also include Honolulu on 15.13 mc, and another station in the same city, KUH27, on 17.9 mc, which also carries the United Nations Chinese programme from 4.0 pm to 7.0 pm. Next month we will try to make a complete study of the USA stations.

PHILIPPINES: Art Cushen tells us about a new Philippine station which has been heard in New Zealand. This newcomer is DXB2, and it operates on 3.95 mc from Davao City. The station is operated by the Mindinaoa Broadcasting Company, Davao College. It has been heard in NZ at 11.0 pm, which would be 9.0 pm in eastern Australia.

At time of writing we have not been able to hear it, owing to the very high noise level on this band, but we imagine that on a favorable night it should be possible to log it over here, as the many other Philippine stations can usually be heard quite well. We would be interested to hear from any readers who have recently received verifications from Philippine stations, as we have been singularly unsuccessful.

JAPAN: Despite their preoccupation in taking part in the fighting in Korea, the Armed Forces Radio Service has still found time to extend their Far Eastern Service, mainly, of course, for the benefit of their troops in Japan and Korea. The latest station to come on the air is JKL4, on 11.8 mc, which is now being heard at quite good strength until it closes down at 6.0 pm.

This station is in parallel with JKL2, on 9.605 mc, which has been on the air for some time now. The programmes are the usual AFRS type and are of high entertainment value, as they rebroadcast many of the domestic programmes from the USA as well as giving an up-to-the-minute news service direct from their own studios in Tokio.

CZECHOSLOVAKIA: The stations in Prague have not been heard recently to the same extent as they were about a year ago, but occasionally one can tune in their native-type programmes when they operate in the 25-metre band. As many of our listeners find difficulty in identifying these foreign-language broadcasts, they will be interested to know that they now have a new station operating in the 31-metre band under the call letters OLR3B, which uses 9.505 mc and which can be heard any morning at 6.30, when their transmission is in English.

Although these stations used to verify listeners' reports quite readily, they now seem to take a considerable time to reply, but usually do so in due course.

NEW STATION LOGGINGS

Call	Kc	Metres	Location	Time Heard
Radio Ceylon	3320	90.36	Colombo, Ceylon.	11.00 pm
DXB2	3950	76.00	Davao, Philippines.	11.00 pm
WMF56	6890	43.51	San Francisco, Cal. U.S.A.	5,00 pm
Radio Ceylon	7190	41.72	Colombo, Ceylon.	11.00 pm
CR7	7260	41.32	Lourenco Marques, Mozambique	6.30 am
Tangier	7270	41.27	Tangier, Tangiers.	7.00 am
WMF29	9010	33.30	San Francisco, Cal. U.S.A.	5,00 pm
OLR3B	9505	31.56	Prague, Czechoslovakia.	6.30 am
Saigon	9524	31.50	Saigon, Indo China.	8.30 pm
WRUL	9700	30.93	Boston, Mass., U.S.A.	7,00 am
4VEH	9755	30.76	Cap Haitien, Haiti.	10.00 pm
WRUL	11780	25.47	Boston, Mass., U.S.A.	6,45 am
JKL4	11800	25.42	Tokyo, Japan.	5.45 pm
Radio Ceylon	11980	25.04	Colombo, Ceylon	11.00 pm
Honolulu	15130	19.83	Honolulu, Hawaii.	5.00 pm
WLWOI	15230	19.70	Cincinnati, Ohio. U.S.A.	6,30 am
VUD	17740	16.91	New Delhi, India.	5.30 pm
KUH27	17900	16.76	Honolulu, Hawaii.	5.00 pm
VUD	21700	13.83	New Delhi, India	5.30 pm

VERIFICATIONS OF THE MONTH

4VEH HAITI: Quite an interesting letter verification was received from 4VEH in Cap Haitien, Haiti confirming reception of their station on 9.89 mc last June. The letter was signed by a Mr. Paul Shirk who stated that the station would also be sending their verification cards when these were received from the printers in about a month's time.

According to the letterhead, the station is operated by East and West Indies Bible Mission which has branches in the Republic of Haiti, Bahamas Islands, and also in New Guinea. Their home office is in Intercession City, Florida and we note their Australian Secretary and Treasurer is a Mr. Alfred Broughton.

VQXV "SENIBUA: Readers will remember we reported reception of the American Tuna Clipper "Senibua" a few months ago and we have now received a very nice letter of verification from the Master, Captain John Mackenzie confirming our report of their 6.22 mc signals.

He said at the time of our reception they were 1300 miles from Sydney, also stated that they were able to talk to their base in Lami, Fiji from Disaster Bay, South of Green Cape a distance of approximately 2000 miles. At the time of writing the letter they had not been able to test their maximum range. No radio operator is carried so the operating is apparently carried out by Captain Mackenzie.

DZB2 PHILIPPINES: Art Cushen tells us that he has received his verification from DZB2 on 3.32 mc in which they stated they were very interested in the good signals this station was providing in N.Z. and went on to say that their present power of 300 watts would shortly be increased to 1000 watts. This frequency is used for pre-tuned receivers in the villages.

We have also received the usual blue and green verification card from the Far East Broadcasting Co., confirming reception of DZH8 on 15.3 mc. On their card they list DZAS 680 kc; DZB2 3.32 mc; DZH6 6.03 mc; DZH7 9.73; and DZH8 15.3 mc, the three latter stations all being well heard in Australia.

YSR EL SALVADOR: Art Cushen is once again the lucky recipient of a much sought after verification, YSR in San Salvador, Republic of El Salvador which transmits on 6.265 mc. It took Art quite a number of letters before they finally answered but it was well worth waiting for.

Their card is colored blue and has the call letters across the top. The power on short wave is given as 1500 watts and the card size was signed by Filipe Ochea Valenzuela, Director of the station. This station can quite often be heard on a Sunday till it closes down any time after 5.0 pm. The programme is the usual dance type with announcements in Spanish.

F.B.S. MALTA: Although the above is not by any means a new verification we are mentioning it as they now verify individual frequencies instead of just sending their card which verified reception report of a certain date but did not mention channel. We wrote to the station pointing out how disappointing this was so they have now sent along their card with five additional pages inserted.

These are typed inserts which read Confirming your reception of our ......kcs transmission at ...... G.M.T. on ...... In our particular case they verified 4,965 mc; 6.015 mc; 6.14 mc; 7.22 mc; and 11.895 mc. No doubt they will now follow this method with all verifications in the future.

ISRAEL HEARD ON 7-12 MEGACYCLES

ISRAEL: According to overseas reports The Voice of Zion was heard for some time on 9.64 mc and later on 9.5 mc with English programme from 7 am till 8 am, with news in English at 7 am. They have now moved back to 8.98 mc and can be logged at this point every morning. Another transmission from this country can be heard on 7.12 mc from 1 am till 2 am, this programme also being in English.

Programme usually consists of talk in English at the half-hour with news at 1.50 am. They announce as, "This programme comes to you from Jerusalem, the Hashamite Broadcasting Service." Prior to the English session they transmit programmes in Arabic and also in this language from 2 am till sign-off at 3 am. We are indebted to Universalite for above.

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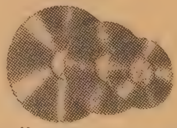

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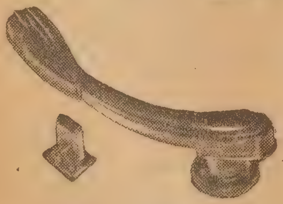

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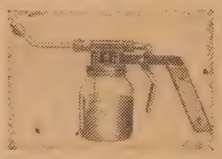

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ELEMENTS OF PULSE MODULATION

(Continued from Page 67)

of Fig. 6. Here four pairs of telephone transmitters and receivers are connected to corresponding segments of a pair of commutators which have brushes or "wipers" rotating in speed and phase synchronism.

A single telephone line circuit connects the brushes so that correspondingly numbered transmitters and receivers are connected together in rapid sequence. If the commutation frequency, or sampling rate, is several times as high as the highest voice frequency used the speech output of each microphone will appear at the matching receiver.

LOWPASS FILTER

A low-pass filter is used in each receiver circuit to separate the speech frequencies from the sampling frequency.

In this system of multiplexing each voice channel uses the wire circuit for a short period of each commutation cycle. Thus, the time of each cycle is divided among the four channels—hence the term time-division multiplex. It will be apparent that this principle will work equally well if the wire circuit is replaced by a radio circuit.

In practical systems of time-division multiplexing, commutation is accomplished electronically rather than mechanically. A synchronising pulse, which is distinguishable from the channel pulses because it is of longer duration, is sent out by the transmitter before each sampling cycle to actuate timing circuits at the receiver.

These timing circuits disable the input circuits of all receiver channels except the one which should receive a pulse at that time. Thus, the receiver "commutator" is automatically synchronised with the transmitter. As many as eight voice channels may be conveniently multiplexed on a single radio frequency circuit by this method.

NOISE RATIO

Systems of pulse modulation which make use of pulses of constant amplitude have signal-to-noise ratios comparable to FM systems. This is because noise modulation variations in the pulse amplitudes can be removed by limiting or clipping circuits such as are used in FM practice without impairing the signal modulation.

Another advantage incidental to the use of pulse modulation lies in the fact that it enables the use of vacuum tubes at frequencies considerably higher than the CW limit for the same type.

The very high pulse voltages applied reduce the frequency limiting effects of electron transit time. In applications where the duty cycle is sufficiently low the upper frequency limit for a given tube type may be more than doubled.

POCKET BOOK STORYTELLER
PRICE SIXPENCE

THE HAM BANDS WITH BILL MOORE

National Field Days are major events in Amateur Radio in England and America and hundreds of stations move out into the field for the day. Australia's National Field Day for 1951 is set down for the Australia Day week-end in January and indications show that this year's event will be well supported.

THE following is a synopsis of the rules:—

1. The day will commence at 1500 hrs EAST Saturday, January 27, and continue through until 2359 hrs EAST, Sunday 28th.

2. The contest is limited to portable stations operating within the Commonwealth and its Mandated Territories, and power is not to exceed 25 watts with the antenna connected.

3. A portable station is defined as one whose power is not obtained from public or private main, is not located closer than five miles from the home location of the operator(s), and not located in any occupied dwelling.

4. No apparatus is to be set up earlier than six hours before commencement of the contest. A station can be moved within a State during the period of the contest.

5. More than one operator can be used, providing they are licensed amateurs.

6. Any amateur band and any number of transmitters may be used providing only one transmitter is used at a time.

7. CW stations will use the call "CQ FD," and phone stations will use "CQ Field Day" to indicate they are portable stations. Attention is directed to the requirements for portable operation, as defined in the PMG's Handbook for the Guidance of Amateur Operators.

8. The contest is divided into three sections—open, CW and telephony.

LOG SHEETS

9. Logs: They should be forwarded through the division, to reach FE not later than 20th February 1951.

10. Stations should submit the most suitable 24 hours of operation out of the full 33 hours. Any lesser period may be operated.

11. Logs should show, location of station, name and calls of operators, description of all equipment used, and power input to final stage.

12. Log entries are to be in the following order: Date, time (EAST), station worked, band used, report sent, received, contact points claimed, bonus points claimed, QTH of station worked and portable operators call.

13. The log must be signed by each operator, with a statement that the PMG's regulations and contest rules have been observed.

14. All VK prefixes are separate VK districts, plus VK5 Northern Territory.

15. A complete exchange of report and QTH is necessary before any points can be claimed.

16. Points will be awarded as follows: Contacts outside competitor's State with fixed station, 1. Contacts with other portable stations within the State, 2. Contacts with stations in Asia, North America, Oceania, 3. Contacts with Europe, 5. Africa and South America, 7. Contacts with portable stations in the contest outside the State, 10.

Bonus for each Continent worked on each band (Oceania outside VK), 25.

Bonus for each new State or country worked on 50 mc/s, 25.

A special bonus for each interstate or overseas contact on 144 mc/s, 50.

Certificates will be awarded to the outright winners in each section, and to the winners in each State in each section.

Certificates will be awarded to each operator of the winning station, provided each operator has contacted at least 25 per cent of the stations worked.

Open orders for equipment will also be awarded to place-getters in each section.

NSW FIELD DAY

THE Annual Divisional Field Day of the WIA, held at Woy Woy in November, was an unqualified success, 150 persons attending, including nearly 100 amateurs.

Visitors arrived from all parts of the State, including VK2WH of Forbes, VK2ARY of Bellingen, VK2AJB Coff's Harbor, VK2OY Goulburn, VK2LY Katoomba, VK2DY Wollongong, Geoff Warner VK9NW of Papua, Arthur Yates VK2ZP of Inverell.

A good attendance from the Hunter Branch and Sydney was also recorded.

Great activity during the day centred around the many mobile and portable stations in operation, thirteen in all operating in the 144mc band, and three on 3.5 and 7 mc/s. The varied and sometimes novel antennae attached to the various cars attracted much attention, especially among passing motorists and local residents.

Beside the hidden transmitter searches on 144 and 3.5 mc/s, several competitions were run during the day, while concurrent with the search others in attendance enjoyed a launch trip on Brisbane Waters.

The hidden transmitter searches created far more interest than on previous occasions, and some very complicated equipment was in use. Seventeen parties participated in the searches, and times required to find the transmitters were shorter than normal. The 3.5 and 144 mc/s stations were locted at different points. The results are as follows:—

144 mc/s. First: Maurice Butler VK2AAN and party, time 23 minutes.

Second: G. Nixon-Smith, VK2AGN and party, time 24 minutes.

Third: B. White, VK2AAB and party, time 26 minutes.

3.5 mc/s. First: Varley Fitten, VK2SF and party, time, 70 minutes.

Second: Wal Nye, VK2XU and party, time, 71 minutes.

Third: Bill Hall, VK2XT and party, time 72 minutes.

Jim Cowan, VK2ZC, supplied and operated the 3.5 mc/s transmitter.

An "Amateur Radio" Quiz of ten questions, covering technical and general topics was also conducted. The winner was Lionel Swain, VK2CS, who answered 8 4-5 questions correctly; second was Jim Cowan, VK2ZC, with 8 3-5 answers correct.

Alf Barnes, VK2CE, Jack Francis, VK2OF, and Harold Whyte, VK2AHA, all scored more than eight out of the possible ten points.

In another competition, a recording of 23 amateur stations operating on the 40-metre band recorded by Harry Hine, VK2ARY, was played back, and competitors were required to identify the voices Jack Hill, VK2ADT, listed 11 voices correctly, and Harold Whyte, VK2AHA, with eight correct, gained the prizes.

Other prizes were won by the YL of VK2ACW, who knew more about L/C circuits than the amateurs present, while associate, Mr. H. Oakes, was second in this competition.

The highlight of the day was a back to childhood event arranged by the Disposals committee. The "Lucky Dip" was charged full of equipment, some pieces good, some bad, others indifferent. One might obtain a defunct 6AC7 or a good 813, it just depended.

All in attendance reassembled at 4 pm for the official section of the programme, and an address was presented by State president Jim Corbin, VK2YC, while the prizes were handed out by the president of the Hunter Branch, Lionel Swain, VK2CS.

The success of the day depended on the efforts of quite a number of members, but special mention should be accorded of Mrs. Hardman and Cess Hardman, VK2KR, John Walker, VK2GA, Major Collett, VK2RU, Jack Francis, VK2OF, Bill Hall, VK2XT, and Jim Cowan, VK2ZC.

SILENT KEY

IT is with deep regret we record the passing on December 1st of Bill Cottrell, VK3AZN and VK2ZN, a very old-timer in NSW amateur radio.

Licensed in the early 20's, and although engaged professionally in radio, Bill was always extremely interested in our hobby.

Recently he was transferred to Ballan, Victoria, after many years of service at Fiskville and Carlingford radio centres. He was a pioneer on the UHF's, besides being an ardent amateur photographer.

Bill was always ready and willing to help any newcomers to the game, and offered advice in his own breezy style.

He will be missed by a wide circle of friends in Amateur Radio. He was a member of the Gladesville Radio Club and the NSW division of the WIA.

DIVISIONAL HAMFEST

DURING the Australia Day week-end the NSW Division of the WIA will present a "Hamfest" celebrating the 40th year of the origin of division.

The event will be run in conjunction with the WIA's National Field Day. An attractive programme has been arranged covering Friday evening, Saturday and Sunday, and it is anticipated that amateurs from various parts of the State will be in attendance The programme is as follows:—

Friday evening, January 26—

Members of the NSW division will be guests of Amalgamated Wireless (Australasia), Ltd., at their factory at Ashfield, where it is anticipated a demonstration of television will be presented. This event will take the place of the normal monthly meeting.

Saturday, January 27—

The venue for the day will be Federation House, Phillip Street, Sydney, and at 2 pm a demonstration of home constructed amateur equipment will be held. A selected number of pieces of gear will be on display, including 576 mc transmitter and receiver, grid dip oscillator, selectojet, turret-tuned receiver, &c.

A short lecture will be presented, and the afternoon will afford city and country members an opportunity of exchanging ideas and yarning.

In the evening a semi-formal dinner will be held with emphasis on entertainment, rather than on speech making.

Sunday, January 28—

VK2WI will operate in the National Field Day, and a picnic outing is to be arranged. Country members are invited to venture out with the official station, or with any of the other stations that will be in the field.

Tickets covering all events, at a cost of 15/-, were distributed at the December meeting, and anyone requiring one can obtain it by contacting members of the council or by 'phoning Jim Corbin, VK2YC, MU1092. It will be a record-breaking weekend, and everyone is invited to attend.

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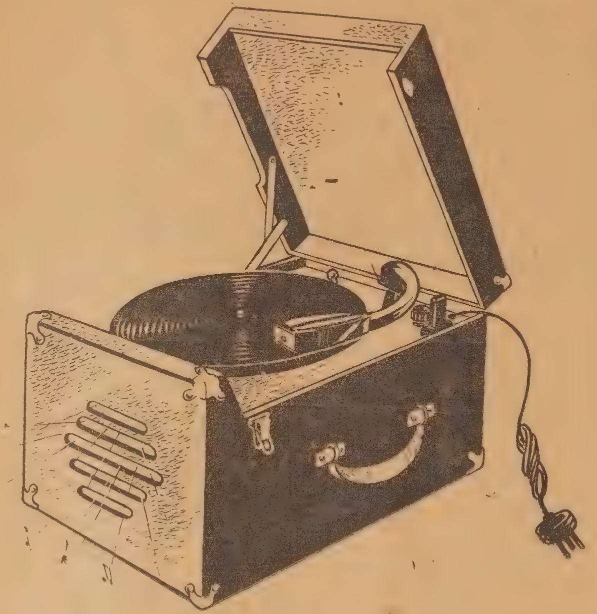
240 VOLT A.C. MAINS OPERATED



This self-contained portable radiogram is equipped with an electric phonograph motor, crystal pickup and 4-valve radio set with 8" speaker. Either 10" or 12" records or radio programmes can be played with ample volume for a small hall. It is fitted with a volume control, station selector, motor switch, radio-phonograph change-over switch and 2 yards power lead. The wooden case is leatherette-covered and measures 12" x 9" x 16". Weight approximately 20lb.

Ready for immediate use £28/10/-

Country orders including freight and packing, £29/10/-. C.O.D. Rail (N.S.W. only) £30/-/-.

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This ready-wired and tested radio chassis is complete with valves and 12" speaker, and is especially designed for the reception of overseas stations. Ultra-modern circuit incorporates iron-cored coils and I.F. transformers, automatic volume control, latest valves: 6SK7, X61M, 6AR7, 6SJ7, 6V6, 5Y3GT, 6U5; large modern edge-lit straight-line tuning dial, four controls: volume control, station dial, tone control, wave change switch; provision for phonograph pickup connections. Overall size of chassis 16" x 10" x 9½" high. Price, £29/10/-, complete, less cabinet, plus freight. Mantel model cabinet to suit, leatherette-covered, size approximately 21" x 13" x 13" high, £4/17/6.

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Opp. Queen Victoria Bldgs.

OUR FREQUENCIES

THE Special Radio Conference that was to have been held at The Hague to finalise frequency allocations as defined at Atlantic City was postponed for at least six months, or until world conditions are more stable.

At the moment it looks as if the conference is off for some time. It means we can forget about the 21 mc band for quite a time.

This adjournment was at the request of the US, who have also suggested that the next Telecommunications Conference scheduled for Buenos Aires for 1952 be postponed until 1957—that is another five years before we have to worry about frequency changes on amateur bands.

The Federal Executive of the WIA, following decisions of the last Federal Convention, made a number of requests to the Postmaster-General's Department, and the following priveleges were granted.

It is now permissible for any amateur station in the frequency bands of 50 mc and upwards to record and re-transmit transmissions from other amateur stations operating in these bands. The equipment so employed must be capable of producing recordings of high quality.

Re-transmissions made at the request of an individual station to be limited to a period not exceeding five minutes in the aggregate in any one day.

A technical talks request was also made to broadcast from WIA stations. It is now permitted to include a technical talk with one broadcast a month, the total duration of which shall not exceed 30 minutes.

It was also requested that a special identifying signal be used for amateurs working emergency traffic. The department raises no objection to the proposal, and the Federal Executive has asked divisions for ideas.

Conditions on the 14 mc seem to be improving, and some good DX has been heard. EQ3FM has migrated from 28mc, and is now operating on 14120 nightly, his QTH APO 205, c/o. PM, NYC. YSIO also active, and his QTH Box 329, San Salvador, Salvador.

George Lee, VK3AGD, recently acquired a WAC Certificate for 28 mc telephony. There are, of course, quite a number about, but George's cards showed an S9 report from each of the six continents.

On 50 mc, the gang experienced excellent conditions in November and early December, practicaly every day supplying one or more sporadic E opening, the ZL's being particularly good.

VK2JU and VK2ADT, made the first VK2/VK6 contacts for the season by working VK6WG. VK2ADT, Cessnock, has also worked through to VK2GU, Canberra, extended ground wave contact, over a distance of 220 miles.

WIA NEWS

THE Ross Hull Memorial Trophy, VHF Contest is nearly over, and the 50 mc band population amassed some excellent scores. The contest this year is being run by the NSW Division on behalf of the Federal Executive, and don't forget logs are due by February 12 to The Contest Committee, NSW Division, WIA, Box 1734, GPO, Sydney.

The Victorian Division of the WIA celebrated the 25th anniversary of their Incorporation in December. A special issue of "Amateur Radio" was published, and a comprehensive programme of entertainment was arranged. The latter included a visit to TAA, Essendon, Field Day at Wattle Park, visits to Lyndhurst Radio Centre, and the VRI Radio Club, and an official dinner was held. All events were exceptionally well attended, and the sub-committees arranging them did excellent work.

The Victorian Division State Convention is set down for the weekend, February 3 and 4.

YOUR OPPORTUNITY —

to join the world-wide ranks of amateur transmitters! The Wireless Institute of Australia holds regular classes in Sydney to assist Sydney and suburban enthusiasts to obtain their Amateur Operators Certificates of Proficiency.

Write for particulars to the Class Manager, W.I.A., Box 1734, G.P.O., Sydney.

A PREAMPLIFIER FOR MICROPHONE

(Continued from Page 39)

Finally a few words on using a microphone. The beginner's first test with such a device is likely to be a trifle hectic. With all the gear connected to a radio, the distance between the microphone and the loudspeaker may be only a few feet. Any attempt to advance the gain will result in an outburst of howls and screeches!

FEEDBACK

This is really caused by the microphone being close enough to "hear" sounds coming from the speaker. These are fed to the amplifier and are reproduced in the speaker at a higher level. Picked up by the microphone again, they are still further amplified, and so the process goes on, building up to a high level of sound.

This effect, usually referred to as feedback, will cease as soon as there is sufficient distance between microphone and loudspeaker. As the gain is increased a greater distance will be required for stable operation.

When using the two units in the same room, the permissible gain will be rather limited. However, careful placement of the microphone will help, and it should be possible to use a gain setting which will, at least, permit close talking operation. Better results will be obtained when the two units can be located in separate rooms, in which case it is usually possible to use all the gain of which the system is capable.

Whether such an arrangement is convenient or not will depend mainly on the type of work being done. For straight out voice reinforcement in large halls or out of doors, such a scheme is not practicable. The audience like to see as well as hear the person speaking. In these cases careful placing of speaker and microphone, with the greatest separation possible is generally effective.

SEPARATION

If you are interested in practising microphone technique, either as performer or technician, you will find it best to operate from separate rooms. In fact such an arrangement is desirable quite apart from the technical angle. If you want to know how a person's voice sounds through a microphone, it is necessary to listen to the reproduced sound alone, rather than when it is mixed with the original.

A setup such as this can also be quite a hit at a party. Given a reasonably well-equipped "studio," a small group of amateur performers can usually turn on a show which will be amusing if nothing else.

When making recordings from a microphone it is advisable to locate the recorder and monitoring speaker in another room, both to eliminate the possibility of feedback, and to help judge the quality of what is being recorded.

While your first impulse may be to lengthen the microphone cable, there are a number of disadvantages to this idea. Shielded cable is essential to these low-level circuits, and with its use goes a certain amount of signal loss. The exact nature of the losses varies considerably under different conditions, and is rather a complex study for the beginner.

In many cases the desired separation may be obtained quite simply by extending the speaker leads, particularly with the permag variety which only requires two connections. Naturally a suitable baffle must be provided for the speaker at its remote location.

Alternatively, an existing extension speaker system may be used, with the main speaker switched out of circuit.

When the gain is fully advanced it is quite likely that there will be a low hum level, caused by the receiver not being effectively earthed.

This is frequently overlooked when the set is used for radio reception, since the capacitive coupling to the power mains is usually sufficient.

However, when high-gain circuits are involved, a more direct earth, such as a water pipe, is necessary.

A JET PROPELLED MODEL PLANE

(Continued from Page 75)

Aim for a smooth fast slightly nose down glide with neither right nor left hand turn. A slight turn in the glide will not be of any great consequence, but too much would lead to trouble when the motor is in operation. The safe thing is no turn at all.

Having satisfied yourself with the glide trim, you are ready to try a Jetex launch. The correct technique is really quite simple.

Ignite the fuse and wait until the jet starts to react before launching. Don't be in a hurry to get it away but wait until a strong hissing sound is emanating from the jet. Then gently spear it away from you in a slightly nose down position. The model will start out in a normal glide path, and as the thrust increases, the job will start to climb rapidly until the power is exhausted. It will then go into a smooth, fast glide back to earth.

In loading the motor, handle the fuel and wick as little as possible as these parts seem to absorb dampness which leads to reduced efficiency.

If you have built light and secured a good adjustment don't use the full 15 seconds run unless you are flying in a big space. This job will climb high and glide far, and on a thermal day is just as prone to out of sight flights as any of our contest models.

There it is, fellas—get jetting!

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17" x 10" x 3" weld ends	22/-
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OFF THE RECORD — NEWS & REVIEWS

Most interesting thing to me this month was the acquiring of some English pressed Decca microgroove records. So far only odd copies have come out here, although I believe that stocks for sale should be available before very long.

By JOHN MOYLE

WHEN records of this type were exported from England to America, they were acclaimed as being of particularly high standard, and better than the equivalent American made discs. With this statement I can completely agree.

In analysing my reactions to these records, it might be most profitable to compare them with ordinary 78 rpm types.

In the first place, the surface noise is infinitely lower. While it is not so low that one can say it doesn't exist, it is so near to this state that it doesn't much matter. It can't be heard at all except on very quiet music. Not the least of the noise is represented by a series of faint clicks, due to dust particles in the fine grooves, or to slight imperfections in processing.

The effective frequency range is also considerably higher than with 78 records. In this respect, however, I would draw attention to the word "effective." I have more than a suspicion that the same recordings as I had are also issued on standard 78 discs, and am pretty sure that I could detect the change from one disc to another at appropriate places in the music where from experience I know such breaks would occur with 78.

But apart from this point, it would seem that the actual recorded frequency range was about the same for the microgroove and the very best of the 78 ffrr types. The big point is that whereas with the 78 records a goodly portion of the high note spectrum was lost in the scratch, in the case of the microgroove no such reservations exist. The scratch level is far too low to have any bearing on effective frequency range.

This combination of low noise and wide range makes these Decca records easily the best example of microgroove technique I have heard to date. In fact, I think it is fair to say that I have never heard sound recorded on discs which was anything like as good.

JUST MUSIC

More than ever I had the impression that I was listening just to music, as one does when hearing a good live artist broadcast. Extraneous noises were so low that the ear could reject them almost completely.

Physically the records appear to be more robust than I had expected. In fact those I played had received a particularly hard life — much harder than they would have experienced under ordinarily careful hands. I thought the surface had stood this treatment particularly well, although here and there a heavy hand with the pick-up had spoiled the first few grooves. These extremely lightweight devices take some getting used to after an old time rock crusher weighing about half a pound!

It must be pointed out once again that to get the best from these records, everything must be right. I don't think this can be considered a disadvantage, however, because with records, it should be right anyhow. Unfortunately we have become used to a number of defects in our record playing, such as noise level and motor rumble, because equipment just hasn't got any better during the last few years in such important matters.

PICKUPS

At any rate, one requires a good 33 1/3 rpm motor, a good microgroove pickup, and a good amplifier system.

While the pickups available at present for microgroove work will give good results after their kind, I hope the manufacturers won't mind me saying that I haven't yet seen a really good microgroove pickup — one which has a really high compliance coupled with a flat, peakless curve, without distortion

FAMOUS
Pianists

and their recordings

SOLOMON
SONATA IN F, L384 (Scarlatti)
CHORALE PRELUDE—SLEEPERS, WAKE (Bach, arr. Busoni) C.3768

JOSE ITURBI
ALLEGRO APPASSIONATA, OP. 70 (Saint-Saens) DA.1889

WALTER GIESEKING
DANSE (Tarantelle Styrienne) (Debussy)
LE PLUS QUE LENTE, Valse (Debussy) LX.1146

VLADIMIR HOROWITZ
DANSE MACABRE (Saint-Saens, trans. Horowitz) (Two Parts) DB.6275

BENNO MOISEIWITSCH
SONATA No. 3, OP. 46 (Kabalevsky), C.3829/30

ARTHUR RUBINSTEIN
RHAPSODY ON A THEME OF PAGANINI (Rachmaninoff) with Philharmonia Orchestra Conducted by Walter Susskind DB.9188/90

Columbia and "His Master's Voice"

Columbia Graphophone (Aust.) Pty. Ltd., Homebush, N.S.W.
The Gramophone Company Ltd. (Inc. in England), Homebush, N.S.W.

CH.74.12

over a range at least to 12,000 cycles. Pickups which are available have some of these, but none has them all. Until such a pickup can be had, one won't get everything this new technique will allow.

A certain amount of de-emphasis, too, will be needed in the amplifier itself. In many cases, this is taken care of by various high note attentuations which often go on in the circuit whether wanted or not. But as more recordings become available, some thought will have to be given here for high grade equipment.

Summing it all up, I was vastly impressed with the English Decca. It is streets ahead of any record I've heard yet. The fact that not until now have I mentioned the long-playing feature is, I think, apt commentary that I am completely convinced it is the key to this record of the future.

LONG PLAYING

Illustrating the long-playing, I have heard a symphony which played for about half an hour, the first movement being on one side, and the second and third on the other side of a 10 inch disc. There was a violin concerto on another ten inch with the same arrangement. There was a twelve inch record each side of which was taken up with five of the best known operatic excerpts for tenor in the form of a recital. Another record, a ten inch, held about six similar excerpts for bass-baritone, including the "Pagliacci" Prologue. These numbers, of course, could be picked out separately if the full side — about 20 minutes playing —wasn't desired.

You've got to experience record playing like this to really understand the relaxation and complete enjoyment which goes with it.

A few things must be remembered when first approaching microgroove records. One important point is this business of wide range. Your ears have been so accustomed to a cut round about the 4-5 kc. mark that you will certainly be surprised to hear so much high note response, and possibly you might even dislike it for a start.

You'll appreciate the point I made some time ago that wide range sound is a demanding business. You just have to listen to it. Soft, tubby, emasculated music may be all right for a background to conversation or reading the paper. But you just can't talk against the authentic shiver of a full orchestral brass, or a tenor voice so real it might be living in the room.

BATTLE OF SPEEDS

There is not much to report on the battle of the speeds except to acknowledge a number of letters received from readers who are obviously just as interested in the outcome as I am.

An interesting aspect of these letters is the almost universal realisation that when considering the new records the exact speed is not the important thing. It is the long playing feature which is considered as being the real advance. Low noise and higher quality, as so many point out, will be obtained anyhow by using better disc material.

If this contention is true, and I must admit I've always agreed with it, then it's hard to see how the 45 rpm record change can have any future.

I don't think there is any doubt that the 45 rpm records of the same groove diameter can give better and cleaner results than do the 33 rpm records, because of their higher slytus velocity. On present groovage, however, they would give only about 4½ minutes per inch as against about 7 minutes for 33 rpm.

THE 45 SPEED

If however, the 45 records are extended to 12 inches instead of the present 7, which would give them something like a standard playing time of 15 minutes per side, we might come as close to making a case for them as we could.

The record changer would probably be forgotten, as it must be anyhow in the long run, unless it can be made to turn the record over and play the second side!

Don't forget this is a fundamental disadvantage of the present 45 rpm idea — you must either turn the records over in the middle of a major work, or buy twice as many discs to get uninterrupted playing. Maximum playing time per side is only 5 minutes 20 seconds. Hail rain or shine, that's all you can do about it. It was designed with the express purpose of chopping up the entire field of music to be fitted to a single size of disc, and playing it back to you in spasms of 5 minutes 20 seconds.

Incidentally when I say that 45 rpm allows better quality, I don't mean to imply that in practice the difference is very great.

CUT PRICE

On the best gramophones, with new discs and everything just fine, they would probably be just that much brighter and snappier. In practice, however, it would probably be more correct to say that the same standard would be easier to reach and maintain in processing with 45 as against 33.

I don't know whether it's significant or not, but I did notice an advertisement in an American trade paper offering RCA record changers plus an album of selected records for about 12 dollars. That's less than £6 our money. As no one could make a profit at such a price, which presumably includes the changer complete with its electric motor, pickup etc., some ill-natured people could perhaps be forgiven if they were to mutter something about the writing on the wall. But is RCA so far into this project that it can't back out even if it wants to? It has always announced that its future in the industry was staked on the new player.

Me — if I had any staking to do, I wouldn't hurry too quickly past a project which had 33 rpm written on it — not right now!

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Amaze everyone with uncanny mental retentiveness. Retain knowledge, facts, with photographic mind. Know new success. Save hours. Recall all in an instant. Make study, work, card games easy. Complete course, 7/6.

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ANSWERS TO CORRESPONDENTS

W. H. G. (Kalgoorlie, WA). Forwards twelve months subscription, and has some nice things to say about Radio and Hobbies. He also details some of the difficulties associated with life in a d-c area, and mentions some experiments he has made with a Helmholtz resonator.

A.: Your subsription has been passed on to the appropriate department W.H.G., and many thanks for your kind remarks. We appreciate your difficulties with only d-c available, but apparently you have made good use of it. Very interested in your experiments with the Helmholtz resonator, and it may interest you to know that at least one imported speaker on the Australian market is designed for use with this type of enclosure. This may save you the task of modifying speakers on future occasions.

E. J. S. (Ormond, Vic.) Enquires whether a suitable circuit is available for use with a 5BPI C.R.O. tube.

A.: A circuit suitable for this tube was published in Radio and Hobbies for February 1948, and a revised version in March of the same year. If you cannot obtain these copies, the circuit diagrams, parts lists, and chassis blueprints are available through our postal service.

K. P. (Roma, Q.) advises that he has not received his September issue of Radio and Hobbies and asks if we will check this matter for him. He also has a word or two of praise for magazine and appreciates the work which goes into the publication.

A.: Your letter has been forwarded to the appropriate department, K.P., and by the time you read this we hope that everything will have been adjusted correctly. We are very glad to hear that you like the magazine. As you say a lot of work goes into each issue, but knowing that our readers appreciate the result is a considerable help.

J. A. W. (South Melbourne, Vic.) is anxious to obtain handbook or circuit of army transmitter receiver set type A.R.T 4A R.C. 16B. He has already contacted the makers without success.

A.: We are sorry we have no information which may be of use to you, J.A.W., but it is possible that some of our readers may be able to help. If so they may care to contact Mr. J. A. Ward, 202 Cecil Street, South Melbourne, Victoria.

J.J. (Tresco, Vic.) enquires if it is possible to fit an extension speaker to the Baby Record Player without harm to any of the equipment.

A.: Yes, J.J., this will be quite in order, and we refer you to the article in September Radio and Hobbies on this particular subject. An alternative scheme to that described is to dispense with the transformer on the extension speaker, and connect the extension leads direct to the voice coil terminals of the main speaker. The other end of the lead connects to the voice coil of the extension speaker. This idea is handy when a suitable transformer is not available for the extra speaker.

C.P.M. (Casino, NSW): Asks us to forward a letter to a reader who recently made a request through these columns.

A.: The letter has been forwarded as you requested C.P.M., and we trust that it will be of some help.

Notreheta” (Ravenshoe, Q.) inquires if the “Simplified Dual Wave Receiver,” described in the November issue is suitable for use in far North Queensland and also if it will cover the range from 13 to 80 metres.

A.: The set is similar to 5-valve factory-made dual wave receivers in general performance and we suggest you listen to such sets in use in your own neighborhood and thereby form your own opinion. You could expect a wide selection of Australian broadcast stations in addition to the usual overseas shortwave stations. However, if you are particularly interested in long-distance reception on either band, an RF amplifier stage is an advantage. We can supply the circuit of a 6-valve set, with an RF stage, through the shilling query service. Ordinary commercial dual wave units usually cover either from 13 to 42 metres or from 16 to 50 metres but if you require a greater range it would be possible to incorporate two sets of shortwave coils and a three-position switch. It is not desirable to cover a range of more than about three to one in wavelength because of the unfavorable inductance to capacity ratio at the long wave end of the band.

R.P.F. (Pinkenba, Q.) asks where it is possible to buy the new 33 1/3 rpm long-playing records.

A.: As far as we know these records are not available in this country at the moment. The few that we have heard have been specially imported for test purposes. You can rest assured that the matter will receive publicity in Radio and Hobbies if and when the records do appear on the commercial market.

YOUR QUERY?

1. Queries will be answered in rotation through the columns of our magazine if not accompanied by a fee for a postal reply.
2. Queries, neatly and concisely set out, will be answered by mail as quickly as possible if accompanied by 1/- in postal notes or postage stamps. Endorse envelope "Query."
3. Back numbers are rarely available but reprints of most circuits, wiring diagrams, and parts lists will be supplied for 6d each, minimum charge 1/-. Thus a circuit, layout, and parts list will cost 1/6 in stamps or a postal note. Endorse envelope "Circuit."
4. Blueprints of exact size chassis layouts with all essential holes, and cutouts will be supplied if available for 2/6. Endorse envelope "Blueprint."

Address your letters to the Technical Editor, "Radio & Hobbies," Box 2728C GPO, Sydney.

To R. T., Marshall Road, Tarragindi: Our letter to this address has been returned marked “post town unknown.” We regret that we are unable to verify by the type number that the operating frequency of the IF transformers you have on hand is in the region of the standard 455 kc channel. A rough deduction could be made by comparing the size of the windings with a transformer known to be on the 455 kc frequency. A local radio serviceman could help you in this respect, particularly if he has a service oscillator and a vacuum-tube voltmeter. With regard to the repair of your three-section tuning gang, we suggest that you communicate with Manufacturers Special Products (Division of AWA), 47 York Street, Sydney, NSW. As a point of interest a resistor color chart was published in the February, 1947, issue of Radio and Hobbies, and is available through the 1/- query service.

J.W. (Fairfield, NSW) points out that he is only fourteen and that he has a lot to learn, but wants to know the meaning of the mysterious symbols AVC and also something about Ohms Law.

A.: No need to apologise for the questions, J.W., we were all fourteeen once, and we all had to learn. More than that, we still have to learn. The letters AVC stand for “automatic volume control,” the purpose of which is to keep the output from the set as nearly constant as possible with varying input signals. Briefly, this is accomplished by picking off some signal voltage just ahead of the detector, rectifying and filtering it, and then applying the resulting d.c. to the grids of the RF or IF valves in such a way as to control their gain. Thus the strength of the signal controls the gain of the set. Where resistance is the unknown factor, Ohms Law formula would be: R equals E divided by I. In this formula R represents resistance in ohms, E is the pressure (in volts) applied to the resistor, and I is the current (in amps) flowing through the resistor. Thus a resistor of 6 ohms would, under pressure of six volts, pass one amp. Either of the other factors may be the unknown ones, and this provides two more versions of the formula. E equals R times I and I equals E divided by R. The meaning of the symbols is the same in all cases.

N.G.S. (Brisbane, Qld.) is worried over the current ratings on the filament windings of a power transformer he has on hand

A.: We admit that to the beginner it probably seems all wrong, N.G.S., but the fact is that you may quite safely connect a single valve drawing only 0.3 amp to a winding which is rated at 3 amps. The rating refers to the amount of current which the winding will safely deliver without overheating. The amount of current which it actually does deliver will depend on the resistance of circuit to which it is connected. In your case it is the filament of the single valve you wish to use, and provided the rated voltage is applied to it, the filament will draw the correct value of current quite irrespective of the rating of the winding.

J.L.M. (Adelaide, SA) writes in appreciation of R. & H. and makes some suggestions about the type of communication set he would like to see described.

A.: Thanks for the suggestions, J.L.M., and we will keep the ideas in mind. However, we feel that a set incorporating all the ideas you suggest would be a rather involved and expensive one, and not likely to be built by more than a few amateurs. The needs of the individual vary so much that it is difficult, if not impossible, to design a set to end all sets. The best idea seems to be that of presenting as many designs as possible covering a wide range of types. This allows the individual to choose the one most suited to both his needs and his pocket, or, where he feels competent to do so, to combine a few features from one with the main design of another.

A.L.M. (Strathfield, NSW) finds it necessary to by-pass the HT line in order to stabilise his receiver. The set has been performing satisfactorily for several years and has only recently shown a tendency to instability.

A.: This trouble can usually be traced to the electrolytic condensers, the impedance of which tends to increase with age, particularly at radio frequencies. Since these form part of the signal return path, an increase in impedance will result in development of signal voltages across this impedance. The return path being common to all stages, signals developed in one stage may be impressed on a previous stage, thus producing all the requirements for feedback. The 0.1 mf condenser which you have placed across the power supply is providing the required low impedance return path which prevents the generation of these voltages. This condenser is usually fitted as a standard precaution, even though the set may perform OK without it when new.

G.G. (Mosman) wants to know how to fit pickup terminals to the Fireside Five.

A.: To fit pickup terminals to this set disconnect the 0.5 megohm potentiometer from the IF transformer winding and connect it to the centre pole contact of a double-pole double-throw switch. The bottom end of the secondary winding of the IFT2 is connected to one pole of the switch, and the “hot” pick-up terminal is connected to the other via a 0.05 mfd condenser. The other set of contacts on the switch are arranged to break the screen supply to one of the preceding valves, preferably the 6U7G. This prevents the radio programme from being heard when the switch is in the pickup position. The pickup is connected to the hot terminal and earth.

SIGNAL GENERATORS

BY "ADVANCE"

Designed for the discerning radio service engineer, the Type "E" Signal Generator is a robust, portable Instrument of exceptional dependability. This high performance is due to the design being based on standard signal generator technique. Its range is sufficiently wide to cover all present needs and likely developments in the servicing and design of radio and television receivers.

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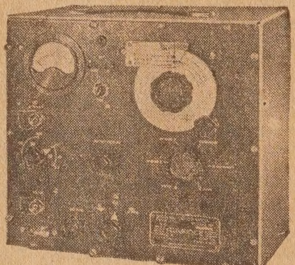

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Internal modulation, variable up to 50%, and also R.F. output, may be monitored by a crystal voltmeter. A 400 cycle A.F. output is available up to 15 volts and provision is made for external modulation.

Calibration is accurate to within plus or minus 1% and output to within plus or minus 1db. The direct reading dial is clearly engraved and setting is facilitated by a high quality slow motion drive, making this the ideal instrument for laboratory and production applications.

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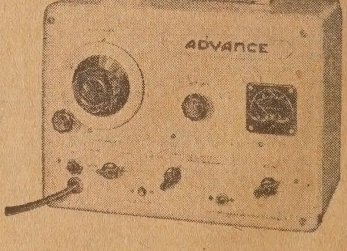
Specially developed for both radio service and factory production engineers, the Type "F" Audio Generator has a frequency range of 0-10,000 c/s and is of particular interest. The range 100c/s-10,000 c/s is substantially level due to the use of a well designed negative feedback network and accurately calibrated to within plus or minus 2%.

Power output is approximately 1 watt into a matched load of 600 ohms, 5 ohms or 10 ohms attenuator and is monitored by a 2 range rectifier type meter. Total undesired signal is less than 3% at full output.

The dial is directly calibrated and is provided with a high quality drive, making this a particularly flexible instrument for audio frequency measurements.



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ANSWERS TO CORRESPONDENTS

H.E. (Rozelle, NSW) wants details for extending the range of multimeter ohms section.

A.: The range can be extended by a factor of 10, only by providing a source of voltage 10 times greater than the highest voltage at present in use. Since in your case this is 15, the new voltage will have to be 150 It is not usually economical to obtain this from batteries due mainly to the high first cost. The drain would only be of the order of a milliamp and, of course, only of an intermittent nature, so that the shelf life would be the main factor governing the battery life. This would mean having to discard the batteries without having taken any appreciable amount of power from them. The best idea appears to be a small AC operated power supply, the first cost of which may not be very much higher than a set of batteries.

This could be made from a small power transformer, such as used in our small sets, having a secondary voltage of 150. Almost any rectifier valve would be suitable, although the 6X5 would be the natural choice if buying a new one, A dropping resistor could be used to permit the use of a five-volt directly heated rectifier if you have one on hand. All the filtering required may be achieved with a single 8mf electrolytic. Connection to the multimeter would probably be most conveniently made to the leads now going to the external battery. Additional resistance must be included in the circuit to make the total value up to 150,000 ohms. Approximately 15,000 ohms will be present in the multimeter already, including the zero adjustment. It is likely that the latter will be too small for use with the higher voltage, and it would be best to make part of the additional resistance variable. A 100,000 ohm resistor and a 50,000 ohm potentiometer make a suitable combination. This additional resistance is to be placed in series with one lead from the power supply to the multimeter The best arrangement would probably be to include the power supply and additional resistance, including the new zero adjuster, in the one case. The leads from the multimeter, 15-volt battery, and the power supply, may be terminated in plugs and sockets for greater convenience.

C.B. (Grafton, NSW) wonders if we have any free buyers' pamphlets dealing with petrol engines, model boats and racing cars.

A.: Sorry, but this is quite outside the normal scope of our service to readers The best we can suggest is that you write to one of the hobby supply stores of which there are several in Sydney. Check through the advertisements in recent issues.

E.C. (Moolya Station, via Eulo), wants us to quote the price for constructing an eight-valve, all-wave, dry battery operated receiver.

A. We regret that we are unable to quote prices for receivers described in R & H, as we do not handle parts or kits, nor do we undertake the construction of these receivers. Most of our advertisers will be able to quote you for a kit of parts for a R & H design, and in some cases they will be prepared to undertake the construction for you. Our files do not contain a design to exactly suit your requirements, the nearest being the All-Wave Vibrator Eight, which was described in R & H for August, 1949. The original copy of this magazine is no longer available from this office, but circuit diagrams, &c., are obtainable through our postal service, price 2/-. A chassis blueprint is also available, price 2/6

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ments first hand, we cannot help you with the circuit

E.K.D. (Gladstone, Qld.) sends 12 months subscription, and makes some suggestions for articles he would like to see in Radio and Hobbies

A.: Many thanks for your subscription E.K.D, and this has been forwarded to the appropriate department We appreciate your power problems, and will keep your suggestions in mind. However we should point out that there have been many vibrator type power supplies described in this magazine from time to time, both in conjunction with receivers &c., and as separate units. Almost all of these would be quite suitable for driving the types of test gear you mention and the instruments would need very little modification. In most cases it would be only necessary to rearrange the filament circuit so that it is fed directly from the battery Also by providing suitable plug and socket connections it should be possible to use the same power supply for a number of instruments

T.B.S. (Singapore, Malaya) is puzzled as to the reason for earthing the centre spigot on miniature 7-pin sockets as these spigots are in no way connected with the circuit.

A.: Briefly, it is necessary to earth the spigots to prevent capacitive coupling between the input and output circuits and consequent feedback which may result in oscillation. We hope to publish an article on wiring methods in an early issue and this article will deal with the subject more fully.

J.P.F. (Bondi, NSW) writes to tell us of his appreciation of Radio and Hobbies and his interest in amplifiers and recorded music. The problem of scratch seems to be the one giving him most bother at the moment.

A.: Many thanks for your kind remarks J.P.F., and it's nice to know that you find the articles so interesting. As you say, the problem of scratch is a serious one, and as you have found, it usually means high notes with scratch, or a restricted response to eliminate it. There is one important precaution in this regard, and that is to avoid any suggestion of pronounced peaks on the upper register, as this will accentuate the scratch level out of all proportion to the high note response. The problem of acoustic needle chatter is really one for the pick-up manufacturers, and later models of the lightweight variety are showing considerable improvement in this regard. In your case some improvement may be possible by lining the inside of the box with sound-absorbent material

J.E.W. (Dubbo, NSW) writes to thank us for some recent information and to detail some of the results which he is now achieving.

A.: Many thanks, J.E.W., and glad to hear that your set-up is now producing such impressive results. The speaker connections as you have them will do no harm, but merely result in a certain amount of mismatch which, in turn, will limit your maximum power output. However, as there appears to be sufficient power for your needs this is not serious

HOW TO BUILD A RADIO RECEIVER

(Continued from Page 65)

By all this we do not mean to infer that set building is hard or that it is impossible for a beginner to build a large set. The object of this article is to point out that there is more to making a successful set than soldering wires together in accordance with a circuit.

If you carefully study other receivers built by experienced technicians and take into account all the points we have mentioned, there is no reason why your set should not work as well as the original constructed in Radio and Hobbies laboratory.

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DOUBLE CONVERSION S.W. SET

oscillator in the fourth. Quite a neat way of doing things.

The circuit shows a good hook-up for a signal strength meter with zero setting. In this set the control works out just nicely for a backwards reading meter having 6db divisions per S point. The set photographed, however, uses a meter reading the HT for the two IF stages only, as we used the 6J5 socket hole for the extra IF transformer. This meter is shunted to read about 25 mills or so.

Note that only portion of the AVC is applied to the RF stage. This is enough to avoid overloading on strong signals but allows the RF valve to operate at good efficiency all the time and gives a good, positive AVC action for operation of the tuning meter. Neither mixer is controlled.

COUPLING COIL

The 5.455 mc. coupling transformer is made from a standard IF transformer by stripping off the old windings and using the former for the new. The details given here should allow it to be lined to frequency by varying the iron slugs, and you should find no trouble on this score.

The windings are tuned with 100 pf mica condensers mounted inside the can. In the possible event of the slugs not giving sufficient control, capacitance can be added or subtracted to tune the coils correctly. However, if you keep to the dimensions shown, failure to line up with the slugs might well indicate some mistake somewhere.

Our set used a large 120 pf bandset condenser to allow easy shift to 19 and 25 metre broadcast stations using the 20 metre coils. Amateurs could easily wire fixed trimmers inside the formers themselves, thus reducing the bandset condenser to a small three or five plate midget to compensate for drift. It would be possible to adjust the bandspread taps accurately enough to eliminate the hand trimmers on aerial and RF coils and, in fact, this is pretty well the case in our own set, but we retained them for flexibility. However, all this is easy stuff and applies to the lining up of any short waver.

The Log dial used may not be easy to get now, but the same movement is included in the Efco type FD32. The glass and its brackets are removed, and the back plate mounted against the back of the panel, with holes drilled for the shaft and pointer spindle. A couple of metal brackets are made to hold a card as for the Log dial, and there you are. The glass can be cleaned and made a protector for the scale if required—you can be as elaborate as you like here. Main point is that this is about the only dial with a good friction drive, and cord drives aren't the best for accurate work.

DIAL SCALES

Good scales can be made from suitable card, ruled in Indian ink with suitable half circles. Some fellows duplicate their finally calibrated scales photographically and make a very nice job. Some even make up pansy escutcheon plates and have them nickel plated.

The finished set, duly checked and lined up, has proved a stable, accurate, high performer. Only on the 28 mc. band has a pre-amplifier proved helpful, and even then, not a great deal. On this band, good aerials are worth any amount of preamplifiers. It has no images, no "ghosts," and no pulling. It just tunes in those stations, smoothly and quietly, one after another. When they are there, of course!

It would probably do quite well on 50 mc. with half-inch diameter coils.

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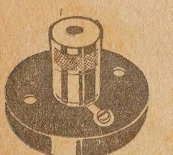

New Invention Crystal Detector

The "Red Spot" highly sensitive semi-fixed permanent crystal detector is now available from **Tenatone Manufacturing Co., Pacific House, 296 Pitt Street, Sydney,** for 9/6, 10/- posted. The "Red Spot" will take the place of the old type crystal and catwhisker and give much better and more constant results. When necessary, it is easily adjusted by means of the knurled cap as illustrated.

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- **Details from Box 1047N, G.P.O., Brisbane.**

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FOR SALE: Garrard 201B Dual Speed Motor, also Decca L. Weight pickup, 12in arm, 2 heads, also Columbia L.W. Pickup, all as new. **R. Molony, 16 Taylor St., East Brighton, Victoria. XB5207.**

FOR SALE: Battery Charger, Petrol Amplion, 300w, 6-12 volt, perf. order £40. **H. West, 2 Queens Rd., S.C.2, Melb.**

FOR SALE: "University" Oscillator, S.O.A. "University" Signal tracer. Both in excellent condition. Price £18. **R. Galbraith, Beechworth, Vic.**

FOR SALE: Eddystone "750" communication receiver. New, without speaker. Best offer. **A. A. McLean, Box 271, Swan Hill, Vic.**

SALE: R. & H. Kar-Set Kit. Complete less speaker. Partly assembled, £12/10/-. **Victoria St., Daylesford, Vic.**

SALE: 11-Tube Receiver. Compass Receiver. **35 Reading Rd., Brighton.**

SALE: Receiver BC348Q and type 3 MII Transmitter-Receiver. Both jobs hardly used and as brand new. **17 Moverly Rd., Kingsford, N.S.W.**

SELL: Bendix RA-10FA Receiver, 240v AC, 3 bands, 500kc—10 megs, or exchange for Palec. Vct. **Simpson, 40 Darling St., Tamworth.**

SELL: Hallicrafters S-29, £25; Command B/C Receiver, £6; A.C. Power Pack, H.D., £22; Meters, Valves, other gear. Multimeter, MCA, £6. Lot £70 or offer. Write for full list, **Collins, 46 Clyde St., Oakleigh, Vic. MB3211 week days.**

SELL: Type 3 Mk.II, new, full kit spares, also MCRI Rec. & 3C Spkr. **K. Goodes, DCA, 475 Collins St., Melbourne.**

SELL: 2-20 M/c high power VFO and P. Pack Receiver, with Q 5a and FM adapt. Also parts. All details from **12 Rose St., Brunswick W., N10, Vic.**

SELL: Caxton's "Modern Radio and Television," complete in 3 volumes, unopened. Also used editions "Foundations of Wireless," "Alternationg Currents," "Radio Training Manual," £7/10/-. **Leslie Louis, South Johnstone, Q.**

SELL: Magnificent double-conversion Ham Receiver (see "Amateur Radio, Mar., '49. **65 Kenmare St., Box Hill, E12, Vic., Night, WX4767; day, MU6259.**

SELL: Valves, new. 3" CRT Meters Power Pack. 5" Speaker, Multimeter. Offer? **15 Larkin St., Roseville.**

SELL: R. & H., Mar. '44, to Dec., '49. 70 copies. Also 29 Radiotronics, £3½. Stamped envelope for reply. **W. D. Turnbull, Cochrane St., West Kempsey.**

SELL: R. & H., Complete 1946-1950. Hobbies Illustrated 1946-1950, incomplete. 67 English Hobbies Weekly's. **Dewey, 109 Sproule St., Lakemba.**

WANTED: Valve & Circuit Tester. Also Gig. Tracer. **R. Genge, 123 Western H'way, Lithgow, N.S.W.**

WANTED: A.R.R.L. Handbook, 1946 or later, good condition. **C. Walker, 122 Windsor Rd., Kelvin Grove, Brisbane.**

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